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A Weekly Review of Current Electricity

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New Advertisements.

In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue: PAGE.

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Vol. IX. NEW YORK, APRIL 16, 1887. No. 16.

IT looks as though the New York subway work will be continued on the old basis by the Subway Company. There is a natural reluctance to adopt any measure that would pledge the city to the work of building the subways out of the common purse.

THE new bonds which the Western Union Company proposes to issue will, it is said, amount to $30,000,000, and will apply to the absolute control of the various companies whose plants are now "leased," namely, the cables, the Gold & Stock system, the Mutual Union, Pacific & Atlantic, Southern & Atlantic, and other land telegraph properties. Dr. Green says that "the scheme is simply in the line of economy and reduction of expenses, and simplifies our capitalization, so that if the government should ever avail of its right, under the act of 1886, to take the telegraph properties, much complication would be avoided." The plan has gone through, but some "kicking" is still anticipated.

WE describe on another page a most ingenious method, due to Prof. Elihu Thomson, for maintaining "balance" on three-wire circuits, in order to prevent the destruction of lamps. His principle consists essentially in utilizing the excess of current in one branch to generate current sufficient to make up the deficiency in the other. The manner in which this is accomplished is not less ingenious than the idea itself. By constructing a machine with two sets of windings on the armature, either of which may serve as motor or generating coils, the motion of the one taking current from the overloaded branch generates a current in the other set of coils sufficient to supply the deficiency in the other branch.

THE calculation *a priori* of the electromotive force of various combinations of metals in galvanic batteries is a subject of considerable interest, and hence the article by Dr. Tommasi, in which he describes a new method devised by himself, will attract attention. The laws developed therein are evidently related to some extent to those already known, principal among which is the one that the specific heat of an element multiplied by its atomic weight is a constant. Dr. Tommasi shows how, knowing the specific heats of combination of the elements, we may calculate the electromotive force between combinations, and this, he shows, is independent of the acid radical or halogen of the two salts constituting the electrolyte, provided both contain the same radical.

THE difficulties which beset those of limited scientific training when they attempt original work is well illustrated in the article on another page, in which a contributor depicts the hardships and trials attending his attempts to obtain a perfect amalgam of zinc and mercury without the admixture of other elements. To those similarly placed, the experience there recited ought to serve as a stimulus to persevere, even under the most adverse circumstances, in the endeavor to improve their knowledge, by experiment and by reading all the available literature on the subject in which they are specially interested. Unfortunately many so situated seem to regard books and "theory" as of no "practical" value, not knowing that just in their cases the value of a good book is enhanced to its utmost limit; and many lack the nerve to go through the trial to the end.

THE Supreme Court of Arizona has decided that the electric current is a fixture. If it had held that the electric circuit is a fixture—meaning thereby the poles, wires, etc.,—it would have been easy to accept the dictum; but it will be seen from the decision which we quote on another page that current is meant as well as circuit. This goes somewhat counter to ordinary ideas on the subject, very much as do the views of the Rev. Mr. Jasper relative to the motion of the sun. Since no one assumes to say just what a current is, the court is probably well within its powers in this case, especially as the suit is to determine the use of electric lighting apparatus; but as a fixture is something tangible and immovable, we think the court might reasonably be asked to get clearer ideas on the subject, and to distinguish between "current" and "circuit." We should be slow to accept the decision as it stands were it not formally printed as good law by the *Daily Register*, legal journal of this city.

NOW that the alternate current machine and the transformer seem to be coming into more general use, a method of testing their efficiency will occupy the attention of constructors. It must be admitted that the problem to be attacked here is by no means a simple one. The ordinary instruments used in connection with continuous current machines are unsuitable for the purpose, and indeed it seems almost impossible to apply a *standard* method to the purpose. For measuring the current directly, the Siemens electrodynamometer alone appears to be available, and as at present constructed it contains several factors of unreliability where great accuracy is required. In the testing of transformers, the calorimetric method, as suggested by Dr. Duncan in another column, seems to be the most available. The measurement of the ordinary constants, such as resistance and current, is made almost impossible on account of the self-inductive effects which mask the true values, and this is also true in the case of the alternating machine itself. In all probability, other methods will have to be called into play. We can, for instance, obtain certain effects with a continuous current, and by producing similar ones with the alternating it would be fair to predicate that the energy expended in the latter case is equivalent to that in the former. We leave it to our readers to devise means for carrying out this idea. Several have already been suggested.

THE statements made by our Western correspondent last week as to the steps being taken to raise the price and quality of carbons are supplemented in this issue by further details on the subject. It will be interesting to see how the combination works and what its effects will be. Obviously, the prime consideration for local arc companies must at all times be cheap supplies, whether coal or carbons or globes, and it is natural some should be open to the temptation of buying carbons because they are cheap rather than because they are good. Hence it is often a mortification to an enthusiast on the subject of electric lighting to see a lamp flicker and sputter and jump, and to see the arc traveling like Japhet in search of a father, when he knows that with a good carbon the lamp would be steady and brilliant. The fact is that the present move is a reaction from the ruinous cutting in prices of the last few years, and has long suggested itself as a *modus vivendi*. From the appearance of new carbon companies, however, it is to be inferred that there will still be some competition in the business.

THE distance to which articulate speech can be transmitted telephonically early occupied the attention of those engaged in that particular work, and while some predicted that its effectiveness would be limited to but a comparatively few miles, later experiments and results show that the limits at present actually talked over are by no means the ultimate ones. The laws upon which the distance involved depends are well set forth in a paper by Mr. Wm. H. Preece, given on another page. It is shown therein that, the number of vibrations or reversals sent over the line by the transmitter being known, the limiting distance for good conversation can be calculated in the same way as the speed of working in cables when the resistance and electrostatic capacity is known. It is shown also by Mr. Preece that there ought to be no difficulty in working telephones through underground wires for a distance as high even as fifty miles. Indeed he seems to think that with wire of the proper size that method of working is preferable to the overhead with iron wires along railway telegraph poles, both on account of electro-magnetic inertia in the iron wire and the absence of external influence, such as induction, which would be met with in the former case. Evidently a single wire underground would not be subject to induction, but it seems likely that unless metallic circuits be adopted the placing of a number of wires in close proximity underground would lead to serious induction troubles.

THE description of the alternating current machine, given on another page, emphasizes the fact that the old ideas with regard to the construction of these machines have been considerably modified of late. Thus a writer in one of our contemporaries remarks truthfully, that the use of iron in the armatures of alternate current machines has heretofore been rather the exception than the rule. The Siemens firm were for a long time almost the only makers of alternate current machines, and in their design no iron is used in the armature, which consists of coils without cores, supported by German silver plates, perforated to avoid eddy currents. The next successful machine in chronological order, which was brought out in England, that of Ferranti, also avoided the use of iron. Some very large machines have been built on this plan and are said to work satisfactorily. A few years ago Gordon attacked the problem afresh, and made his huge dynamos, now working in the Paddington depot installation. There the armature, or to speak more correctly, the double armature, fixed on either side of a system of revolving field magnets, consists of copper coils placed over iron cores formed of bent boiler plates. The amount of work which can be done by a given weight of armature wire is naturally very much increased when iron cores are used, and it is naturally regarded as astonishing that, in face of the great improvement which has resulted from an increase of iron in the armature of constant current machines, the makers of alternate current machines have not adopted iron cored armatures long ago. It seems that there was some prejudice against iron, for some reason or other not very clearly understood, but in some vague manner considered to be connected with magnetic lag, molecular heating, eddy currents, self induction, and other phenomena. This idea, however, seems now to be dissipated, and in the construction of alternate current machines in this country, such as the Westinghouse, iron is employed as in the continous current machine. It seems to us that the rules which apply to such work, if properly carried out, ought to insure success, and principal among these is the necessarily complete lamination of the iron subjected to the influence of the alternating currents. Certain it is, that if the secondary generators or converters can be made to stand up under their work, there is no good reason why the same should not be the case with the armature of the machine itself. It may, no doubt, require a larger amount of iron in construction than is necessary in the continuous current machine, but that is one of the necessary accompaniments of the problem to be solved.

NEW BOOKS.

La Machine Dynamo-Electrique. By Dr. O. Frölich. Translated from the German by E. Boistel. Paris: Baudry & Co. 1887. 6½ × 10 inches. Pp. 262.

Dr. Frölich's studies embodied in this work are well known. His avowed object is to replace empiricism in dynamo construction by laws which, with given assumptions, shall dictate the designs and proportions to be adopted. Naturally theoretical considerations gain a prominent place in the volume, though these are all based on experiment. While mathematical formulæ are frequent throughout the work, they are mostly of a practical nature directly available for practical application.

The author treats in succession the various types of machines, the series, shunt and compound, and adds a short disquisition on the magneto-electric machine. In this part he treats of the various actions in the machines, and the relations between the current and magnetism.

The dynamo is next considered as a motor and generating machine. The calculations for winding the different types of machines, with given constants, such as current, potential, speed, etc., are fully entered into, together with other details of construction and operation. The effect of remanent magnetism in the field is also treated of, and an interesting note on the mode of taking measurements from machines is also included here.

The book concludes with a study of the transmission of power by electricity with motors in series with constant current, and with motors in both series and parallel at constant potential. While similar in some respects to Thompson's *Dynamo-Electric Machinery*, this work is, nevertheless, distinct in its method of treatment of the subject, and is well worthy the attention of the student and engineer.

Note on Magnetic Resistance.*

BY PROFESSORS AYRTON AND PERRY.

Two iron rings about 6 in. in diameter made from the same bar of best Swedish iron about ¼ in. in diameter were wound with insulated wire in two halves, so that a current should be sent round either or both halves, and the resulting induction measured by the throw of a ballistic galvanometer placed in series with a few convolutions of wire wound round the outside of the main winding. One of the rings was continuous, and the other had a small air-space of about 8 mm. in a plane perpendicular to that of the ring and passing through its axis, as if the ring had been cut by a saw. The primary object of the experiments which were made by Messrs. Aldworth, Dykes, Lamb, Robertson, and Zingler, of the Central Institution, was to determine whether there was any appreciable "surface magnetic resistance." The results do not show any such resistance, and the relative resistance of air and iron as calculated from the unsaturated parts are about as 1200 to 1, a number agreeing fairly well with those obtained by other experiments. From this the authors conclude that for small distances magnetic resistance of air is proportional to length. When the magnetizing current was passed round the one-half of the divided ring on which the test coil was wound, a greater induction coil could be obtained than by any other way of magnetizing, and this the authors do not attempt to explain. Mr. Bosanquet said he had always found greater inductions obtainable in the middle of bar electro-magnets or open magnetic circuits, than could be produced in closed magnetic circuits, and thought the above observations confirmed his own results.

A Method of Testing Secondary Generators.

BY DR. LOUIS DUNCAN, JOHNS HOPKINS UNIVERSITY.

In testing apparatus of high efficiency, it is better, providing the measurements can be made with approximately the same accuracy, to measure the loss and the total energy absorbed, than to calculate the efficiency from measurements of the total energy absorbed and that given out. For instance, if A_t is the energy absorbed; A_e that given back; and l the loss; then if we measure the first two we have:

$$\text{Efficiency} = \frac{A_e}{A_t};$$

if we measure the last and either of the first we have

$$\text{Efficiency} = 1 - \frac{l}{A_t}, \text{ or } 1 - \frac{l}{l + A_e}$$

In the first case, any error in either of the measurements would enter almost directly in the result; in the second, providing the efficiency be high, errors in the measurements would have comparatively little weight. For example, if the efficiency were about 90 per cent., then by the first method an error of 10 per cent. in A_e or A_t would cause an error of about the same amount in the calculated efficiency. But by the second method 10 per cent. error in l or A_t would only cause about 1 per cent. error in the efficiency.

With secondary generators it is not difficult to measure the loss. The apparatus could be sealed, to prevent water from injuring it or short-circuiting the coils, placed in a vessel, the radiation from which has been experimentally determined, and then water could be allowed to flow through uniformly, the temperatures of ingress and egress being noted and the escape water weighed. There should be a stirring arrangement to keep the water in the vessel at a constant temperature throughout, and this temperature should be known, as also the work expended in stirring.

After a time the arrangement will settle down to a state of equilibrium as regards temperature, and if—

t_1 = temperature of ingress.
t_e = " " egress.
t_o = average temperature of vessel.
t_a = " " " air.
α = coefficient of radiation.
J = mechanical equivalent of heat.
H = work expended in stirring.
W = weight of water.

We will have:

$$l = WJ\{(t_e - t_1) + \alpha(t_o - t_a)\} - H.$$

The other quantity necessary to calculate the efficiency should be the energy in the external circuit of the secondary, preferably measured by a calorimeter. Thus:

$$\text{Percentage efficiency} = 1 - \frac{l}{l + A_e}.$$

I am not aware that this method has ever been tried, and it is easier to write this than to look up the not very extended, but rather diffuse, information on the subject.

*Abstract of a paper read before the London Physical Society.

The History of an Electrical Invention.

BY JOHN BEATTIE, JR.

A few paragraphs will give the readers of The Electrical World a history of my work leading up to the final accomplishment of uniting zinc and mercury in the crucible. For several years previous to the year 1879 I was engaged in the business of granite dealer and contractor at Fall River, Mass. Business was good, and I purchased an old run-down farm and improved it. The said farm possessed splendid possibilities, situated in a beautiful country, and was purchased for the same reason that a gambler purchases a railroad ticket before entering into a "skin game," *i. e.*, so that he will not have to walk home.

In my business as granite dealer I determined that it was best to use electricity to fire charges of powder and "rend rock," and bought a powder-keg frictional blasting machine. When first purchased the machine would give an inch and a half spark; however, in the course of time the length of the spark was reduced to half an inch. But (having been bitten by the electrical tarantula fifteen years previous to this) I wanted to know *why* the spark was reduced, and upon investigating I arrived at the conclusion that the "rubber" required amalgamating. I consulted text-books, went to work and made an amalgam. In the making of the latter I reversed the process of the text-books, put the mercury into the ladle, and, when the mercury was hot, added tinfoil thereto, with better results than I got by adding hot mercury to the molten tin.

In a short time I, for good reasons, gave up the idea of using a frictional machine, and built an induction or Page coil, putting thereon several miles of wire. At the same time I put my name on the back of little bits of paper for my friends, to rest myself as it were. The result of the two operations, building the coil and indorsing for my friends, was that the sparks broke through the coil, and the indorsing went far towards breaking me.

I then had a magneto machine with a Siemens armature built from my own designs. In winding the armature I found that electricity was something that when you did not want to insulate it, it was already insulated, and when you wanted to insulate it, it was difficult to do so. A friend lent me one of Professor Farmer's dynamos to use in my quarry. I found that to be the most satisfactory instrument to use for firing exploders, and made up my mind to build one. I soon disposed of my city property, quarry, home, library and all, saving from the wreck a few of my scientific works, and removed to my farm, "farmed" it some, studied electricity, chemistry and medicine; found out that $\frac{E}{R} = C$, or rather why it was so; made some resistance coils, bridges and galvanometers—"crude" is no name for some of them—"doctored" sick horses and cured them; "doctored" sick human beings when the doctors gave them up, cured them also; sunk wells into the rock when others "got stuck;" took the money earned in the above-mentioned operations and put it into my favorite science, electricity. I have now a dynamo built from designs (furnished to one of your contemporaries by G. M. Hopkins), wound in such a way that it will heat eleven inches of No. 36 platinum wire red hot.

I made a dry battery on Trouvé's principle to run a pendulum that would beat seconds, put the wires under ground in a box made of laths, connected them to a telegraph sounder, and hung the pendulum in the barn; the sounder was in the house one hundred or more feet away, and I astonished the natives by having a clock running in the barn and having to come to the house to hear it tick. That pendulum was so well made that it did not vary one-fifth of a second in five hours' run. I had a "hen-coop lath" for a rod, and the bob was made of lead and zinc. The zinc was a mixture of my wife's stove zinc, amalgamated zinc from my old "Grove" used in my induction coil experiments, sheet lead and shot.

I wanted soon what we are all looking for, more light, and in order to get it made a modification of the "Bunsen," using Mrs. Beattie's fruit cans, candy jars, porous cups that disintegrated after one or two trials, retort carbons sawed into strips, and the stove zinc amalgamated by the usual, and some unusual, process, with not very satisfactory result; but I learned why by Professor Seely's process of cutting shingles, *i e.*, cut and try.

I then made up my mind that I would make a union of mercury and zinc in the crucible, and succeeded in doing so in 1884 to my entire satisfaction, although from my previous experiments the course was clear. My text-books said that zinc and lead could only be united in small quantities without the addition of arsenic. That explained why the shot united with the zinc so well. The shot seemed to be more easily melted in the mercury than the sheet lead was. In order to be sure I took some sheet lead that I had purchased to make a storage battery with, melted it in mercury, and added arsenic. Wanting to try a flux to prevent any possible escape of mercury, I took some of my wife's washing soda and used it in the ladle. The result was as desired. I had solved the problem of uniting mercury and zinc in the crucible.

I then started to make a motor "that would mote." Thanks to the teachings of Prof. Henry Morton, Carl Hering, Silvanus Thompson, and last, but not least, the editors of The Electrical World, I have succeeded beyond my expectations.

My funds were low in 1885. On March 23, 1886, I mortgaged a paid-up life insurance policy in order to get money to get a patent on my motor and medical battery. I could not get any one to assist me to perfect my work so that I might put it on the market. I was called cranky; wet blankets were thrown on me by my *friends* for encouragement. I told them that I had valuable inventions that I wanted to patent. It was no use talking; no one would help me. I then took my favorite Scott breech-loader, that cost me $250, and mortgaged it for $100, took the money and applied for my zinc patent, which I have since obtained.

I tested my amalgamated zinc by putting it in sulphuric acid and water, 1 to 10, and no local action that I could see took place. No loss of weight ensued after forty-eight hours' immersion. Zinc pencils of this type have been in daily use in Leclanché cells for three months without having crystals formed on them. The contrast is very striking between my zincs and commercial amalgamated zincs used in clock circuits. My own look like new, while the others turn black and have crystals formed on them.

In conducting my experiments there are two things which have embarrassed me; first, the lack of a good education, and second, money; but with my own earnest endeavors and outside help I hope to "get there just the same."

In closing, I will say that I can unite zinc and mercury by heat without having the mercury volatilize and escape. I consider this invention of mine of great commercial importance, because it will increase the efficiency of every zinc used in an open circuit battery. I also believe that closed circuit batteries will be made cleaner, longer lived and more efficient, without any great increase in the cost of material.

Mercury Connections for Secondary Batteries.

Writing on this subject to *L'Electricien*, M. Reynier, who has had some experience with mercury contacts for secondary batteries, says: "Relating to the fears expressed as to the permanent efficiency of mercury contacts, I ought to say that these contacts have been in use at Marly since August, 1886, upon 'forming' circuits (in 'forming' plates for the Reynier battery). They have always acted well, while thousands of plates have been 'formed' through them, the electrolyte being sea-water, which is far more corrosive than ordinary acid. In fact, the perfect action of these contacts in such unfavorable conditions has decided M. Blanc to adopt this plan for general use with accumulators."

A New Standard Cell.

M. Guoy describes in the *Comptes Rendus* a cell suitable for use as a standard of E. M. F., and which possesses some advantage over the Latimer-Clark cell in that its E. M. F. is as high as 1·39 volt, whilst the temperature correction is said to be only about ·0001 per degree C. The cell is practically equivalent to a Latimer-Clark, in which the sulphate of mercury has been replaced by the peroxide, HgO. The cell is made up with a layer of mercury at the bottom, in contact with a platinum wire sealed into the glass, a layer of oxide above the mercury, and sulphate of zinc on the top. The E. M. F. does not arrive at its final value until the cell has been made up for several days; but after this, when measured on open circuit, it is said to remain constant within ·001. Care should be taken to avoid agitating the cell unnecessarily, for, as in the Latimer Clark, the E. M. F. is slightly affected by any disturbance of the mercury. The cell also polarizes very strongly if a current is taken from it, but quickly recovers its normal condition on open circuit. The tendency to polarize when used for zero reading on the galvanometer—that is, with short contacts only—is said to be quite negligible. On the whole, it would appear from this description that the substitution of oxide for sulphate of mercury produces an ele-

ment whose working qualities are about on a level with the Latimer-Clark, while it possesses the distinct advantages of a higher E. M. F. and a lower temperature correction. It is, however, a little early to decide finally on the merits of these cells, since M. Guoy has only studied their properties within the last three months.

An Electro-Pneumatic Dispatch Tube System.

Pneumatic transmission of dispatches between main stations in large cities has been practiced to some extent for a long time, but no general introduction of the system has ensued. There can be no doubt, however, that for the carrying of parcels, letters, etc., the system presents a number of advantages. In the case of large establishments also where cash boys are employed, the saving in expense by the employment of such a system is quite marked.

It is but recently that, with the employment of electricity in connection with improvements in the details of working, Mr. James F. McLaughlin, of Philadelphia, has designed a system of this kind, in which one single tube serves the double purpose of both forwarding and returning the carrier over the line between any one station and the central office or exchange, thereby simplifying, as well as reducing, the cost of construction and operation, at the same time insuring the certain delivery and return of the carrier and dispensing with more than one-half of the tubes which have heretofore been necessary in systems of this kind.

Each tube of this apparatus is furnished with an automatic annunciating device for indicating to the operator at both ends, the arrival and departure of the carrier, as

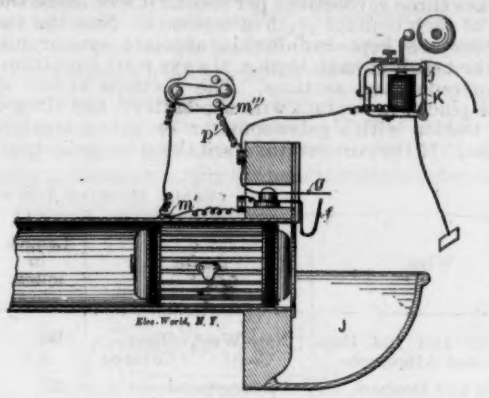


FIG. 4.—DETAILS OF ANNUNCIATOR.

nunciators at the station ends are similar in construction, except that the drop requires no insulation.

A button switch *O* is placed at each terminal station, the lever of which is connected to the tube at *m'*, and the switch point in circuit with the magnet *K* of the annunciator and the spring *g*. The binding post on the tube *m'* is also connected with spring *f*, and magnet *K* is connected to ground.

Thus, when a carrier is inserted in the mouth of tube *A* nected by means of line to the binding post *m'* of each terminal station, which in turn is locally connected to both the switch point *m'''* and the spring *f*.

The annunciator at *A''*, at exchange *B*, has the usual drop; but it is so constructed that the current passes through the prolonged magnet core, through the drop which is insulated below, and then by wire into the coil *K*. The annunciator at the other end, causing the drop to fall there, which notifies station *D* that a carrier has started from the exchange. The current then paeses to ground.

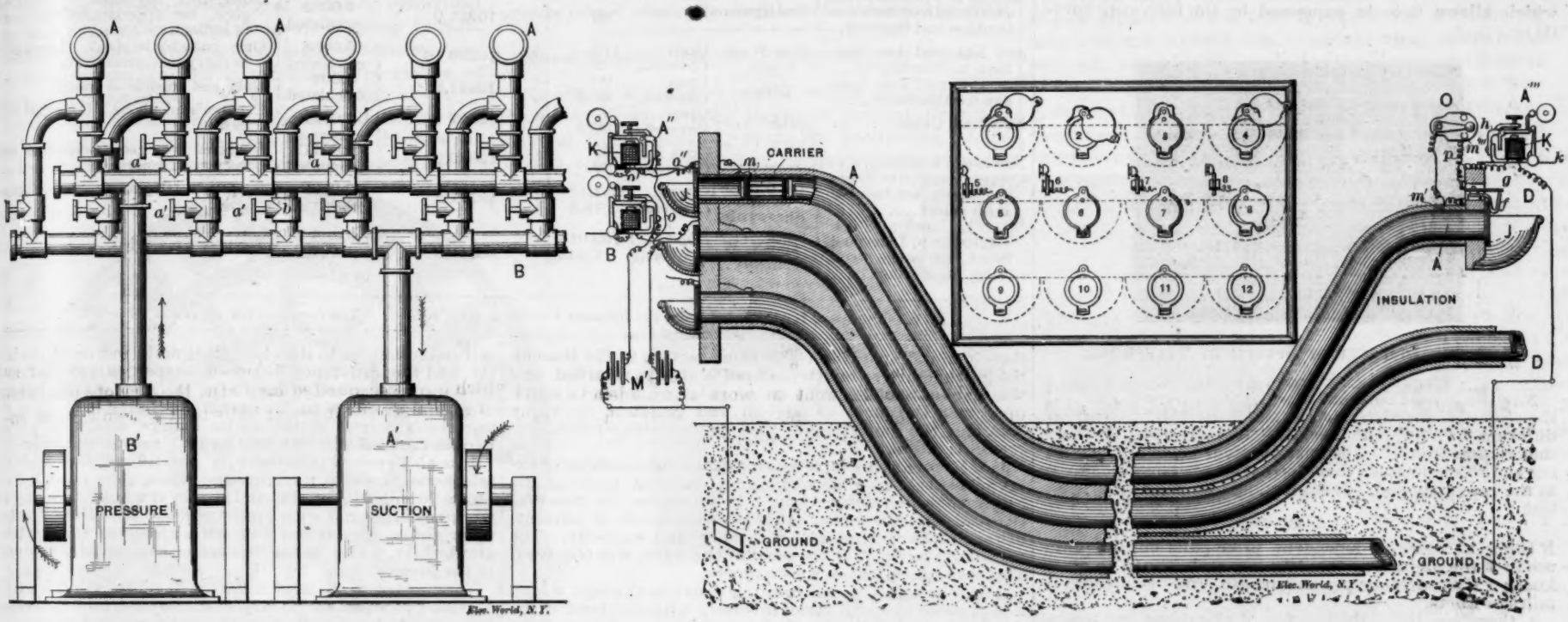
In this way, the instant the carrier is prepared to leave the exchange, the operator at any terminal station to which it may be destined is notified of its coming, and upon its receipt the exchange is immediately informed of its safe arrival.

The carrier employed in the service is shown in perspective in Fig. 5, and in longitudinal and transverse sections in Figs. 6 and 7. As will be seen, its sides consist of stee bars or rods, and the ends are provided with elastic rubber heads. It is thus able to turn sharp corners or curves and to withstand rough usage. The carrier is provided with a side opening, through which the contents can be inserted and removed. It also contains a flexible removable shaft on which manuscript, letters, etc., can be rolled and properly secured for transmission. A rubber washer at each end fits snugly in the tube so that no air can pass either way.

One of the main features of the system lies in the fact that Mr. McLaughlin uses the metallic insulated tubes to conduct the electric current which operates his signaling devices, thus obviating the necessity for a line wire for that purpose.

The same invention is designed as a cash carrier or service for stores or warehouses or between any points where a sufficient quantity to be transported will warrant the installation of such a system.

It is the inventor's intention to install the system in Philadelphia and eventually to place the same in other cities wherever favorable municipal concessions can be obtained which will allow the company to lay their pipes.



FIGS. 1, 2 AND 3.—AN ELECTRO-PNEUMATIC DISPATCH TUBE SYSTEM.

the metallic tubes are the lines or paths for the current from the main battery. And the apparatus for applying the power used in transmitting the carrier to and fro is arranged in such wise that it can be changed and directed to both forward and return it through the same tube.

The manner in which this is carried out is shown in the accompanying illustrations. In these Fig. 1, *A A* represent the exchange ends of the different tubes, at which point there are placed pressure and suction blowers *A' B'*. Each tube may be put in connection with either pressure or exhaust by means of the valves *a a'* shown, so as to give the carrier any desired direction of motion in the same tube.

The general plan of the arrangement of the tubes and the electrical signaling mechanism is shown in Fig. 2, while Fig. 3 shows the ends of the tubes at an exchange station.

It will be seen that with this system there is but one tube connecting to any one station *D* and the exchange *B*. The tubes are thoroughly insulated from the ground, and they constitute an electric line for the transmission of the electric signals employed in the working.

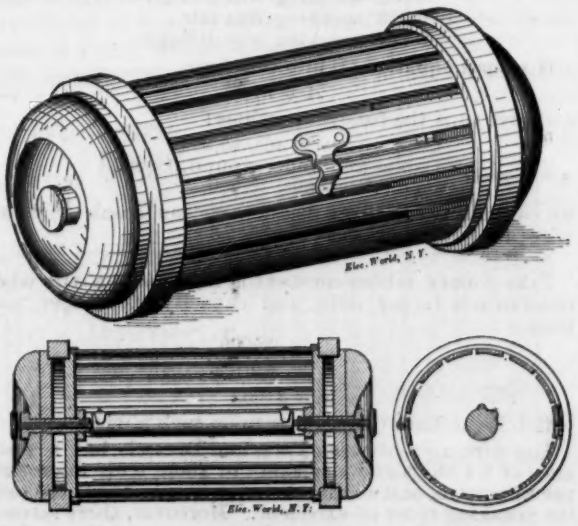
When an operator at any of the initial stations *D D* desires to send the carrier to any destination whatever, he first removes the hinged door and inserts the carrier in the open end of the tube. This action automatically signals or indicates to the operator at the exchange *B* that the carrier has started to its destination, and he consequently opens the door at the exchange end, so that the carrier may fall in the receiver *J J*.

The diagram, Fig. 4, shows the manner in which the signaling is effected. It will be seen that each station end of the tubes *A A* is provided with a depending spring *f*, above which is placed a spring finger *g*, insulated from the former, but so placed that they make contact when the carrier is inserted in the tube. It will be seen that only the terminal station ends of the tubes are provided with these springs, the exchange end of each tube merely having an annunciating apparatus] *A''*, electrically connected by means of line to the binding post *m'* of each terminal station, which in turn is locally connected to both the switch point *m'''* and the spring *f*.

The annunciator at *A''*, at exchange *B*, has the usual drop; but it is so constructed that the current passes through the prolonged magnet core, through the drop which is insulated below, and then by wire into the coil *K*. The annunciators at the station ends are similar in construction, except that the drop requires no insulation.

A button switch *O* is placed at each terminal station, the lever of which is connected to the tube at *m'*, and the switch point in circuit with the magnet *K* of the annunciator and the spring *g*. The binding post on the tube *m'* is also connected with spring *f*, and magnet *K* is connected to ground.

Thus, when a carrier is inserted in the mouth of tube *A* at station *D* (the switch point *m'''* not being in contact with the lever), the spring *f* is forced in contact with spring *g*, which automatically closes the circuit from battery *M'* up through wire *o*, through the drop and coil *K*. The latter being energized allows the drop to fall, thereby announcing to the exchange that a carrier is ready at station *D*. The course of the current is traced from magnet *K* by wire *o''* by the tube into spring *f*, etc., with ground return. The operator at station *D* now changes the switch lever, bringing it in contact with the point *m'''*.



FIGS. 5, 6 AND 7.—VIEW AND DETAILS OF CARRIER.

Now, when the operator at the exchange wishes to signal to station *D* that a carrier has started back, he merely replaces the drop (which has been previously forced down by signal from station *D*), which action will close the circuit from battery *M'*, and the switch lever being, as before stated, in contact with point *m'''*, the current will pass over the line into magnet *K* of the annunciator at the other end, causing the drop to fall there, which notifies station *D* that a carrier has started from the exchange. The current then paeses to ground.

In this way, the instant the carrier is prepared to leave the exchange, the operator at any terminal station to which it may be destined is notified of its coming, and upon its receipt the exchange is immediately informed of its safe arrival.

The carrier employed in the service is shown in perspective in Fig. 5, and in longitudinal and transverse sections in Figs. 6 and 7. As will be seen, its sides consist of stee bars or rods, and the ends are provided with elastic rubber heads. It is thus able to turn sharp corners or curves and to withstand rough usage. The carrier is provided with a side opening, through which the contents can be inserted and removed. It also contains a flexible removable shaft on which manuscript, letters, etc., can be rolled and properly secured for transmission. A rubber washer at each end fits snugly in the tube so that no air can pass either way.

One of the main features of the system lies in the fact that Mr. McLaughlin uses the metallic insulated tubes to conduct the electric current which operates his signaling devices, thus obviating the necessity for a line wire for that purpose.

The same invention is designed as a cash carrier or service for stores or warehouses or between any points where a sufficient quantity to be transported will warrant the installation of such a system.

It is the inventor's intention to install the system in Philadelphia and eventually to place the same in other cities wherever favorable municipal concessions can be obtained which will allow the company to lay their pipes. The development of this new electrical application will be watched with much interest.

Duplex Working of Single-Needle Circuits on the Caledonian Railway.

It will no doubt be interesting to some of our readers, says London *Engineering*, to know that the somewhat despised instrument, the single-needle telegraph, has recently been turned to good account by being duplexed. Pressure of work upon the Glasgow-Carlisle circuit necessitated that some improvement should be devised in the working of a new wire to meet the anticipated summer traffic. Mr. A. S. Dunn, the superintendent of the Caledonian Railway telegraph system, has recently devised and applied a simple method of duplexing the single-needle instrument, and it is in work over a circuit nearly 110 miles long with the best results. This is accomplished by differentially winding single-needle coils, but it is found by later experiments there was no necessity for going to the expense of doubly wound coils, seeing that the ordinary coils of the single needles, by being split at the brass connection at the back of the coils, will answer equally well. This is simplifying duplex working immensely, and will no doubt be largely taken advantage of.

A Red-Hot Telephone Transmitter.

Professor G. Forbes and Mr. John Munro have recently made some experiments with a red-hot wire as a telephone transmitter, an account of which has been communicated to the Royal Society. A fine platinum wire, from .001 to .005 in. in diameter, and several inches long, was included in the circuit of a charged accumulator and the primary wire of an induction coil. A receiving telephone was connected in circuit with the secondary wire of the induction coil. The battery power was such that the fine wire in the primary circuit was heated to a high temperature and rendered incandescent. When in this condition, on speaking to it the words could be heard in the receiving telephone,

The explanation of the phenomenon is that the sound waves passing the incandescent wire in quick succession altered its resistance by cooling, and thus varied the strength of current in the primary circuit. The fluctuations of current thus caused excited corresponding fluctuations in the secondary circuit, and these reproduced the voice in the receiver. Spiral wires in the form of watch-springs, of steel and platinum iridium, were tried in place of the straight wire with some success. An india-rubber diaphragm was also interposed between the voice and the heated wire, and found to influence the wire like the direct voice. Mechanical vibration did not affect the apparatus.

On the Limiting Distance of Speech by Telephone.*

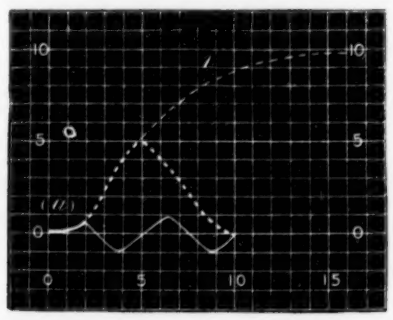
BY WILLIAM HENRY PREECE, F.R.S.

The law that determines the distance to which speaking by telephone on land lines is possible, is just the same as that which determines the number of currents which can be transmitted through a submarine cable in a second. The experimental evidence upon which this law is based was carried out in 1853 by Mr. Latimer Clark (whose assistant I then was). The experiments were made by me in the presence of Faraday; many were his own; he made them the subject of a Friday evening discourse at the Royal Institution, January 20, 1854, and they are published in his "Researches" (Vol. 3, p. 508). They received full mathematical development by Sir William Thomson in 1855 (Proc. R. S., May 24, 1855), who determined the law, the accuracy of which was proved by Fleeming Jenkin and by Cromwell Varley, and the 110,000 miles of cable that now lie at the bottom of the ocean afford a constant proof in their daily working.

Hockin reduced Thomson's law to the following series:

$$x = C\left(1 - 2\left\{\left(\tfrac{1}{4}\right)^{\frac{t}{a}} - \left(\tfrac{1}{4}\right)^{\frac{4t}{a}} + \left(\tfrac{1}{4}\right)^{\frac{9t}{a}} - \left(\tfrac{1}{4}\right)^{\frac{16t}{a}} + \text{etc.}\right\}\right),$$

which allows it to be expressed by the following curve (1):



Limiting Distance of Speech by Telephone.

Now a is a time constant dependent on the conditions of the circuit, invariable for the same uniform circuit but differing for different circuits. It represents the time that elapses from the instant contact is made at the sending end to the instant that the current begins to appear at the receiving end. It is given by the following equation:

$$a = Bkrl^2,$$

B being a constant dependent principally on the units used; k the inductive capacity per unit length (mile or knot); r the resistance per unit length, and l the length in miles or knots.

a, therefore, limits the number of vibrations per second that can be sent through any circuit. If a be 0.196 second, as it was in the French Atlantic cable of 1869,† 2,584 knots long, then it is impossible to send 5.1 currents per second through that cable; but it would be possible to send 5 or 2½ complete reversals per second. Moreover, as the number of reversals varies inversely with the square of the length, it shows that such a cable, if of 100 miles length, would allow 1,562 reversals to pass through it. It is necessary to remark that these expressions involve no mention of E. M. F. or of current, and therefore the number of reversals which can be produced at the end of a wire is quite independent of the impressed E. M. F., and therefore of the strength of the current. But the number of reversals is dependent upon the sensitiveness of the apparatus used to receive the currents, for if we use an instrument which will respond to a current indicated by the full line, we get two currents per second; and if we use an instrument which will respond only to the dotted line, we get only one current in two seconds, which is about the current used with delicate relays in this country. This is why such discordant results are obtained by different observers who attempt to measure the velocity of currents of electricity. It is also why the telephone is such an admirable instrument for research—for it is sensitive to the least increment or decrement of current.

Before proceeding with this inquiry it was necessary to determine very accurately the inductive capacity of overhead and underground wires. This was done with great care on very dry days in different parts of the country by means of a Thomson mirror galvanometer and a standard condenser.

The results come out as follows:

	Capacity per mile microfarads.	Resistance per mile B. A. ohms.
No. 7⅛ iron wire	0.0168	12.0
No. 12½ copper wire	0.0124	5.7
Gutta-percha covered wire in iron pipes	0.2500	23.0
Gutta-percha-covered wire in cables	0.2900	10.25

The capacity can be calculated from the following formula (also due to Sir William Thomson):

$$K = \frac{l}{2\log(4h/d)}$$

where d is the diameter of the wire and h the height above the ground. Taking h at 500 cm. and d at 0.243 cm., the capacity comes out for 12½ wire at 0.0113, instead of 0.0124 microfarad per mile. The cause of this difference is referred to further on.

It then became necessary to determine the speed of the current through wires of different lengths, resistances and capacities.

A Delany multiplex distributor—such as we are now using in the Post-Office—enables this to be done with great accuracy. At each station a circle is broken up into 162 sections, and an arm in connection with the line wire carrying a brush sweeps over these sections and makes contact. This arm can be made to rotate at any speed. If it makes three revolutions per second it will make the duration of each contact $\frac{1}{486}$th of a second. Now the two distributors are kept running in absolute synchronism, so that the brush at each station always rests simultaneously on corresponding sections. The sections at one station can be placed in contact with the battery, and those at the other station with a galvanometer or other sensitive apparatus. If the current traversed the wire instantaneously then it would appear on the same section at the time on the galvanometer; but the current is always retarded, and the amount of retardation or the value of a can be measured and the curve of arrival and cessation drawn by watching the indications of the galvanometer on each succeeding section.

TABLE SHOWING THE SPEED OF CURRENT THROUGH WIRES.

Wire.	Route.		Length in miles.	Total resistance × Total capacity.	Speed of current in seconds.	Telephonic notes.
Nos. 142 and 144, Denham and Atherstone	New West Coast	Open	90	2247.0	0.0007 calculated	Gower-Bell telephone. Speaking good.
		Covered	2.5			
London and Denham	Underground		21	2963.5	0.0009 calculated	Ditto ditto
Nos. 142 and 144, Denham and Stafford	New West Coast	Open	119	4715.7	0.0015 calculated	Gower-Bell telephone. Speaking fairly good.
		Covered	5			
South Wales		Open	79	5680.0	0.0016 calculated	Gower-Bell telephones. Working satisfactorily.
		Covered	1.25			
Newcastle telephone system, Warkworth to Stockton P O	Via Newcastle, Sunderland and West Hartlepool	Open	63.831	5817.6	0.0016 calculated	Gower-Bell telephones. Five intermediate electro-magnets, of 1,000 ohms resistance, in derived circuit. Speaking satisfactorily.
		Covered	12.039			
Nos. 142 and 144, London and Towcester	New West Coast	Open	50	7341.3	0.00234 calculated	Gower-Bell telephone. Speaking weak, but able to hold a conversation.
		Covered	21			
Nos. 142 and 144, Denham and Nantwich	Ditto.	Open	146	7612.1	0.0034 calculated	Gower-Bell telephone. Speaking weak, but just able to carry on a conversation.
		Covered	7			
London to Denham (with additional loop between Denham and Hanwell	Underground		39	10221.0	0.0032 calculated	Gower-Bell telephone. Speaking good, but approaching the point of difficulty.
Nos. 142 and 144, Denham to Warrington	New West Coast	Open	172	10399.16	0.0038 calculated	Only just able to speak. Impossible to carry on conversation.
		Covered	8			
Nos. 142 and 144, London to Atherstone	Ditto.	Open	90	12511.2	0.004 calculated	Only just possible to speak.
		Covered	23.5			
New Irish Cable	Cable	Open	25	12587.4	0.00412 observed	Berliner's telephone. Only just able to talk.
		Covered	62.9			
Newcastle district		Open	30	12640.0	0.00412 calculated	Requires very good telephones and very good voices.
		Covered	30			
Copper. London to Nevin (land lines for the new Irish cable)	Via Worcester and Shrewsb'ry	Open	251.18	15771.5	*0.0035 observed.	Berliner's telephone. Some voices good.
		Covered	18.5			
No. 11, London Stock Exchange to Liverpool Stock Exchange (iron wire, No. 8 gauge	Via London and N. W. Railway	Open	199.014	*	0.005 observed.	Telephone not tried.
		Covered	7.243	16417.8		

N. B.—The speed is calculated from the formula $t = 32 \times 10^{-8} KR$. * The constant for copper is 22×10^{-8}.

The accompanying table summarizes a large number of experiments that have been made in different parts of the country, and on different lines, to determine by observation the connection that exists between speed of current, distance spoken through, resistance and capacity. The maximum current, or the crest of the wave, was observed. This was equivalent to 0.003 ampère.

It will be seen that the limiting distance through which it is possible to speak varies inversely with the speed of the current, and that the speed of the current varies inversely with the product of the total resistance and the total capacity of the circuit. Hence we can say that the number of reversals that it is possible to send through any circuit varies inversely with the product of the total resistance (R) and the total capacity (K), or the limiting distance

$$S = KR \times \text{constant} \qquad (1)$$

This is only another form of Thomson's law for $K = lk$, and $R = lr$, and

$$\therefore S = krl^2 \times \text{constant}.$$

It is seen that when the speed of the working current was

0·001′ speaking was perfect,
0·002′ speaking was good,
0·003′ speaking was fair,
0·004′ speaking was difficult.

If we put equation (1) into this form,

$$A = krx^2 \qquad (2)$$

and give to A the following values:

Copper (overhead), 15,000.
Cables and underground, 12,000.
Iron (overhead), 10,000.

we can find the limiting distance we can speak with any wire; for

$$x^2 = A/kr.$$

Take copper, whose constant is 15,000, and a wire whose resistance is 1ω per mile, and capacity 0.0124 per mile, then—

$$x^2 = \frac{15000}{0.0124},$$

$$x = 1100,$$

which is the limit of speaking upon such a wire.

The wire used between Paris and Brussels has a resistance of 2.4 ohms and a capacity of about 0.012 microfarad per kilometre, and as that distance is only about 200 miles the speaking must be excellent. Moreover, there is reason to believe, from the difference between observation and calculation, that the static capacity on Continental and American lines is less than that of English lines, owing to the use of earth wires on all poles in England, and therefore the distance would be greater.

Take an Atlantic cable—

$$x^2 = \frac{12000}{3 \times 0.43},$$

$$x = 96.$$

Now I had found in 1878* that it was just possible to speak through 100 miles of such a cable—a very close agreement.

Moreover, by the law of the squares, 100 miles of an Atlantic cable ought to transmit 1,562 reversals, if 2,584 miles transmit 2½, and this is probably the average number of sonorous vibrations imparted by the human voice, when hearing by telephone begins to get difficult by the loss of the higher partials and overtones.

There is another interesting consequence of Thomson's law which comes out of these experiments, and that is, whether the line be a single wire completed by the earth, or a double wire making a metallic circuit, the rate of speed between the two ends is exactly the same, and therefore the distance we can speak through is just the same whether we use a single or double wire circuit. This is owing to the fact that though in the latter case we double the total resistance we halve the total capacity, and therefore the product remains the same.

The difference between copper and iron is clearly due to self-induction, or to the electromagnetic inertia of the latter, and the difference between copper overground and copper underground is due to the facility that the leakage of insulators offers to the rapid discharge to earth at innumerable points of the static charge, which in gutta-percha covered wire can find an exit only at the ends.

It is also evident that there is no difficulty in working telephones through underground wires, even though they attain 50 miles in length, and in fact it would be better to work underground with proper copper wire from London to Brighton, than to use iron wires along the railway telegraph poles, owing to the absence of external disturbances in the former case.

The limit of working of different insulated wires is easily obtained by equation (2), and the following table gives that information for different gutta-percha-covered wires.

No.	k.	r.	Limit of speech.
20 / 11	0.270 mf.	45.00 ohms.	32 miles.
18 / 7½	0.250 "	23.00 "	46 "
16 / 4	0.240 "	13.00 "	62 "
107 lbs. / 150 lbs.	0.290 "	10.25 "	64 "

N. B.—The top number indicates the gauge of wire, and the lower number that of the gutta-percha.

The Diamagnetic Space.

BY F. JARVIS PATTEN.

In view of the apparent difficulty of finding a good technical name for the space that lies between the armature core and the pole pieces, the following suggestion is offered:

Why not call this space what it really is? It is a break in the magnetic circuit—through one limb of the magnet, the yoke, and the other limb the magnetic circuit is continuous, unbroken. Between the poles lies the armature, whose iron core is another magnet with supplementary poles, but practically a continuation of the first. Through this core the magnetic circuit is completed, being continuous *through magnetic matter*, with the single exception of the narrow space that separates armature core and pole-pieces. This space is mainly characterized by its want of magnetic susceptibility; it is occupied by matter that has no magnetic properties. Therefore in technical language this is the only part of the circuit that is diamagnetic. Why not then call it the "Diamagnetic Space?" since this term expresses clearly, technically and scientifically what the nature and properties of the space are with reference to the forces under consideration. The word is no worse than dynamo-electric and others in common use.

"Air-space," "Windage," and all terms of that character, will necessarily be defective because they exclude the copper winding upon the outer surface of the armature core, which in some machines fills a large proportion of the "Diamagnetic Space."

* Read before the Royal Society.
† Fleeming Jenkin, "Electricity and Magnetism," p. 331.

* "Phil. Mag.," April, 1878.

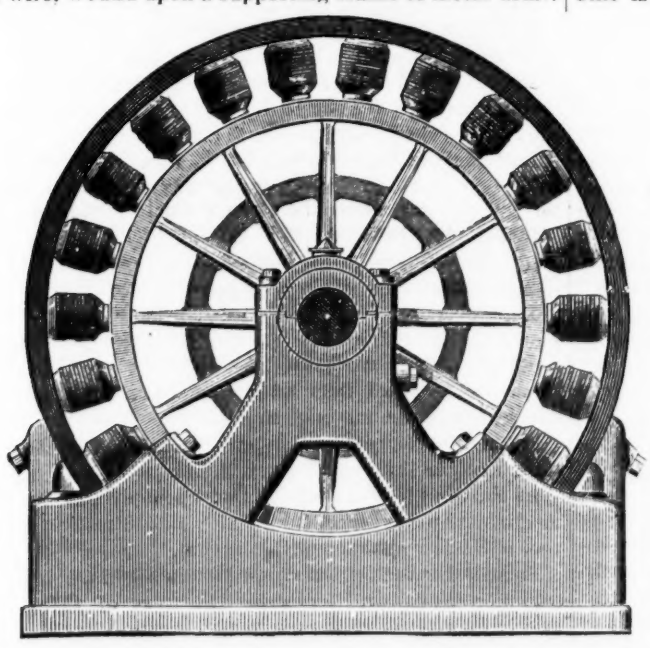
Lighting the Paris Exhibition of 1889.

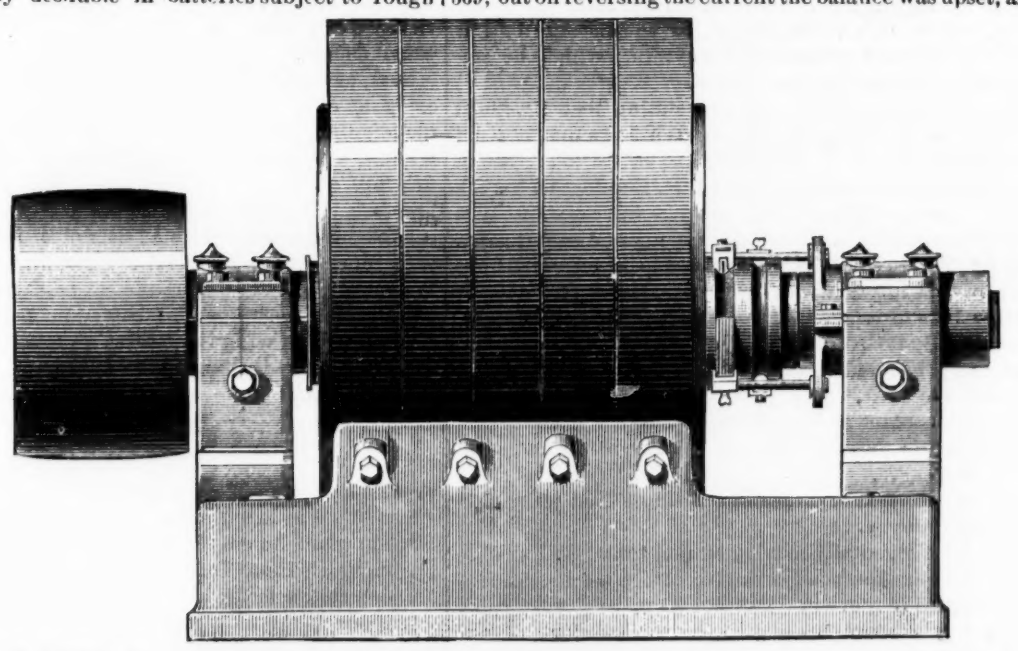
The terms agreed upon for the lighting of the Paris International Exhibition of 1889 by the syndicate of French electricians are as follows: The syndicate is to supply light to the extent of 250,000 candle-power, and the actual cost is estimated at from 2,500,000 fr. to 3,000,000 fr., depending in part upon the period during which the exhibition remains open, probably somewhere between 150 and 180 days. The consideration agreed upon is to take the shape of one-half share in the receipts for admission during the evening (at 2 fr.), and the right to charge a tariff to the exhibitors in certain classes under a scale approved by the commissioners. Another clause provides, however, that as soon as a net profit of 500,000 fr. has been made, the syndicate is to return one-half of its subsequent gain to the commissioners. Upon the basis of the experience gained in the previous International Exhibition at Paris it is estimated that the receipts available for division will amount to between 6,000,000 fr. and 7,500,000 fr. The expenses are therefore expected to be at least fully covered from this source, leaving the charge to the exhibitors and extra receipts on special occasions as clear profit.

The Elwell-Parker Alternate Current Dynamo.

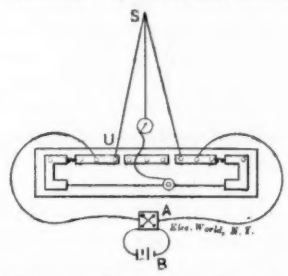
We illustrate on this page an alternating current dynamo recently designed by Messrs. Elwell-Parker, of Wolverhampton, England, which embodies several novel features of design. While in some recent constructions the armature coils are laid on the outside of the core, in the machine under notice the wire is wound over the core in the usual Gramme fashion, although not connected as a Gramme ring. In this machine, the system of field magnets is a fixture, consisting of a heavy cylindrical yoke and twenty-two radial magnets pointing inward, while the armature revolves. In larger machines, however, the armature is a fixture, surrounding a system of revolving field magnets.

The core of the armature of the machine illustrated consists, as usual with the dynamos made by this firm, of iron wire, wound upon a supporting frame of metal arms. Formerly Messrs. Elwell-Parker tipped the ends of these arms with strips of fibre, in order to insulate the core from the rest of the machine; but this provision was found to be, electrically, a useless refinement, and, at the same time, mechanically objectionable, because the fibre is not a sufficiently reliable medium for the transmission of the power from the spindle to the core. The makers, with a view to insure a more perfect grip between the arms and the core, now wind the latter upon the former without any insulation. Another departure has been made with regard to the central casting. Formerly it was considered by most electricians an absolute necessity to make the arms and hub of some non-magnetic metal, and most makers, even to this day, use gun metal for this purpose. Where the diameter of the armature is small the additional expense thus entailed is trifling, but in larger armatures the substitution of cast iron arms results in considerable economy. Where the distance between the poles is small, as compared with the diameter of the armature, there is, on theoretical grounds, no objection to the use of cast iron, and in this machine, where the arms and hub are one iron casting, the practical result has confirmed theory. The wire is wound in twenty-two distinct coils, corresponding with the twenty-two field magnets, and all the armature coils are connected in series, the two terminals being brought to a pair of contact rings, against which brushes slide, as shown on the right in the illustrations. One of these machines, says *Industries*, from whom we reproduce the illustrations, was erected about five months ago at the Eastbourne electric light installation, to work a number of transformers used for the lighting of that town. The armature is 36 in. diameter and 30 in. long. The wire is coiled on it in a single layer, and a space of one inch is allowed between adjacent coils. Thus, only 90 in. of the total circumference is covered by winding. The total number of turns is 640, and at 600 revolutions the E. M. F. is 2,000 volts, while the normal current is 30 ampères. The total length of wire wound on the armature is 41,000 in., of which 19,200 in. are on the external surface. This gives 20.5 in. of total and 9.6 in. of outside wire respectively required for each volt at the terminals. The resistance of the armature is 2.4 ohms, and, owing to this low figure and small self induction, the machine is practically self-regulating. The resistance of the field magnets is 19 ohms and an exciting current of 10 ampères from a separate small dynamo is required to maintain the magnetic field. The total weight of the machines is about four tons. From the figures given it will be seen that the machine works with 220 alternations per second. It is evident the higher the rate of alternations the more work can be got out of a given weight of material, both in the generator and in the transformers, and it is worthy of note that whilst some years ago alternate current machines were built to give only about 100 reversals per second, this number has now been more than doubled, and probably in the future even a quicker rate of alternations will become the usual practice.





FIGS. 1 AND 2.—ELWELL-PARKER ALTERNATE CURRENT DYNAMO.



TEST OF CONDUCTIVITY OF WIRE VERTICALLY SUSPENDED.

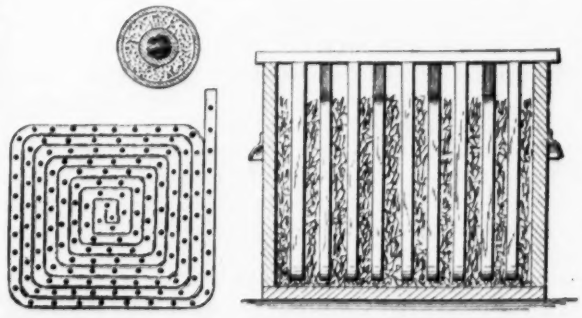
Novel Construction for Storage Battery Plates.

The efforts of most inventors of storage batteries lie in the direction of devising means to prevent the active material from separating from the conducting plates. This is specially desirable in batteries subject to rough handling and jarring, such as those designed for railway work, whether for lighting or power.

With these points in view, Mr. J. T. Van Gestel, of this city, has designed a form of storage battery which possesses several novel features of construction.

The plates of this cell consist of a flat rectangular spiral, shown in Fig. 1, wound from a continuous length.

The material from which the spiral is made is shown in section in Fig. 2. It consists of an outer tube of lead which is filled with the active material and through which runs a lead-covered copper wire. After being coiled the spiral is pressed into rectangular shape and perforated so as to permit the entrance of the solution.



FIGS. 1, 2 AND 3.—STORAGE BATTERY PLATE OF NOVEL CONSTRUCTION.

The plates, when placed in the cell, are separated by crushed glass, as shown in Fig. 3. The glass, well packed, keeps the plates in place, and allows at the same time a circulation of the liquid, but prevents spilling of the latter.

Mr. Van Gestel has designed special machinery for making 2,000 feet of the plate material per hour; the whole tube and contents being run out complete, ready to be coiled into plates.

The Electrical Conductivity of Vertically Suspended Wires.

At a meeting of the London Physicial Society held on March 12, Mr. Shelford Bidwell read a paper entitled as above. He said that from the ceiling he suspended a copper wire 35 ft. long; the end at the bottom was left free, and he found that the electrical resistance was slightly greater when an electric current was passed from the bottom to the top, than when the current was passed from the top to the bottom. With iron, the reverse of this took place. If one-half of a wire be stretched and the other half be free, heating will be observed at the place of junction on the passing of an electric current. The 35 ft. wire he had already described, was not specially stretched at the bottom; but it was stretched more and more by its own weight towards the point of suspension. It might, therefore, be supposed that the temperature of the wire was very slightly increased under the action of the downward current, since a battery current from stretched to unstretched wire will absorb heat, and *vice versa*. The accompanying sketch represents an ordinary meter bridge, with 100 ohms put into each of the two gaps. *A* is a reversing key, and *B* a battery. In copper, the thermo-current passes from *S* to *U*, therefore the battery current, if flowing in the same direction, absorbs heat and diminishes resistance; if flowing from *U* to *S*, it evolves heat and increases resistance. The same electromotive force was used in the experiments with the iron and copper wires; the specific resistance of iron was seven or eight times greater. The Peltier effect varied with the current. The resistance of each copper wire was 1.05; in copper, the difference in each wire was 0.000158 ohm, or about sixteen thousandths per cent., which (taking variation per degree centigrade to be 0.004) implies a difference of temperature of less than $\frac{1}{25}$ degrees C. A two-cell battery was used. When the wire was copper, he obtained a balance when the slider was at 569; but on reversing the current the balance was upset, and the slider had to be moved. The results of several experiments are given in the table, the figures indicating the positions of slider:

Copper.			*Iron.*		
Direct.	Reversed.	Diff.	Direct.	Reversed.	Diff.
569	644	64	780	770	10
567	637	70	760	748	12
595	651	66	759	748	11
Mean.....		63	Mean.....		11

These experiments were made about eighteen months ago, and he hesitated to publish them, because of the liability to error. It would be well to try the experiments on a larger scale, with wires down a coal pit or clock tower.

Professor Silvanus Thompson thought a long wire was not necessary; a short wire might be loaded from top to bottom. Mr. C. V. Boys said that short wires might be attached to an axis, and rapid rotation would then give them a far greater tension than gravity. Professor A. W. Rücker said that with a loaded wire the heat would not be distributed regularly throughout its length. Mr Bosanquet stated that he had been greatly inconvenienced by thermo-electric currents from the use of brass binding screws, and he, therefore, had to make every part of his apparatus of copper; he had produced the currents even by laying his fingers on the binding screws. He thought that E. M. F.'s must exist in the arrangement described by Mr. Bidwell.

Visiting "Electricals."—Under the guidance of Mr. G. F. Curtiss, a number of the "electricals" of the Massachusetts Institute of Technology visited the New York offices of THE ELECTRICAL WORLD last week while on their tour of inspection of electrical institutions and novelties. The Institute gives ample promise of maintaining its repute for turning out good electrical engineers

The Denver Electric Railway.

To the Editor of The Electrical World:

Sir: Referring to the publication in your issue of the 2d inst., of an article relating to the electric street railway, now being operated in Denver, Col., by Mr. Sidney H. Short, we beg to say:

On the 29th day of November, 1884, our Mr. Knight received the following letter:

"Cleveland, Ohio, Nov. 29, 1884.

"*Walter H. Knight, Esq., City:*

"Dear Sir: We make the following extract from a letter received from Prof. S. H. Short, of Denver, Colo., to whom we made a proposition * * * for the electric railway franchise for the State of Colorado. Mr. Short is endeavoring to dispose of the franchise to several gentlemen at Denver, and says in relation to them:

"'They are also corresponding with the owners of the patents on the cable system, and we have them to compete with in our efforts to make this sale. Would you be kind enough to send me full particulars as to the methods of constructing and operating this system of street railroading; also the probable cost of constructing and running the same? I wish to be familiar with these facts in order that I may more fully present the claims of the electrical roads, and make a favorable comparison with the cable line.'

"Please give Mr. Short any information in regard to the construction and operation of the electrical road that you may deem advisable to further his project.

"Yours respectfully,

(Signed) "The Brush Electric Co.,

"By W. F. Swift, Sec'y."

A correspondence ensued between Mr. Short, his associates, and the Bentley-Knight Electric Railway Company lasting over a considerable period in 1884 and 1885, during all of which time Mr. Short was an earnest seeker after information relative to the proper methods of constructing, operating and equipping electric tramways, Mr. Short's ostensible desire being to secure such information as would enable him to introduce the Bentley-Knight system in his State, and the company gave him full benefit of all such information as it could forward him, with special reference to the question of conduit construction.

It was with some surprise that we have since found that Mr. Short has utilized all matter forwarded him by us in the production of a "system" of electric tramway equipment, whose sole virtue seems to be the use of our methods, with the avoidance of anything which he imagined was covered by our patents.

We take pleasure, therefore, in stating that Mr. Short has not been so successful in doing this as he undoubtedly imagined he would be, and we call attention to the patent No. 359,050, issued to Mr. Edward M. Bentley, on the 8th day of March, 1887, the application having been filed October 14th, 1885, and now the property of this company. This patent absolutely covers all series electric railways for street purposes which are not already covered by patents heretofore granted to Messrs. Bentley & Knight.

Specifically it covers:

1st. Any inclosed section switch, operated by a device connected to a car.

2d. Any contact and switching device for a series railway, which is movable laterally relative to the car, so as to round a curve.

3d. Any turnout or branch in a single line series electric street railway.

4th. All horizontally-moving section switches.

5th. Any double ended contacted device for a series railway adapted to move in either direction.

6th. Any contact bearing on a vertical face of the sectional conductor.

We are unable to see how Mr. Short's so-called invention can exist, except as a plain and open infringement of the rights belonging to this company, by virtue thereof.

Bentley-Knight Electric Railway Company,
By Robt. W. Blackwell, Gen. Manager.

New York City, April 7.

Output of Dynamos per Pound of Copper.

To the Editor of The Electrical World:

Sir: A statement made in the last issue of The Electrical World, by Mr. E. S. Dobbie, needs considerable correction.

I refer to the following remark: "* * Nor do I see that the capability of the Thomson-Houston machine to run without iron is any recommendation, especially when we consider that the weight of copper on the armature is three or four times that of other machines of the same capacity and efficiency when the iron 'is there.'"

Mr. Dobbie has evidently made the serious mistake of comparing the output per pound of copper of arc light machines with that of incandescent machines. This, out of justice to Mr. Dobbie, we should say is an error frequently made, but such comparisons are misleading, and it is about time that they should cease.

The watts per pound of copper should only be used in comparing the relative merits of machines of the same class or type, *i. e.*, between long arc dynamos, short arc dynamos, incandescent dynamos, or other distinct types of dynamos designed for certain special purposes.

All experienced designers or builders of dynamo-electric machinery know that it is necessary, in order to obtain the best practical results, to design dynamos for the special work which they are intended to perform.

This is particularly true in the case of dynamos intended to operate what are called "long arcs" in series. Here the relative proportions of iron to copper, of armature strength to field strength, the position of the neutral line, the self-induction of the armature coils, etc., have to be carefully considered and arranged. The machine must be capable of producing not only a steady current over a steady resistance, but over a circuit liable to sudden and great variations in resistance. The same thing is true of the "short arc" machine, although to a much less degree. It has thus far been found necessary to make the ratio of copper to iron mentioned above greater in the "long arc" machine than in the "short arc," and very much greater than in the incandescent machine; the incandescent machine on account of the nature of its work permitting of the least possible amount of copper in proportion to iron.

No one would think of judging of the correctness of design of a locomotive engine solely by comparing the coal used per h. p. hour with that of a compound marine condensing engine. Yet the cases are somewhat parallel.

While it is true that all dynamos are dynamos in the same sense that all steam engines are steam engines, that all horses are horses, yet there are different types of dynamos, engines and horses. Some are built for high pressure, high speed, specialized work; others for low pressure, low speed and heavy work. Each has its peculiar virtues and vices, and is designed to fill its own peculiar field. Comparisons, to be of value, must not be made between members of different classes or types, or if between members of different classes or types, they must be made on a broader and more comprehensive basis than the mere output of per pound of copper.

With the above remarks we will now give some data regarding the Thomson-Houston machines designed for long arc work, and also those for incandescent work.

The 50-light 2,000 c. p. machine which the Thomson-Houston Company has now had on the market for about two years gives an E. M. F. of 2,600 volts and 10 ampères of current, or a capacity of 26,000 watts useful work. The armature contains 290 pounds of copper with a working resistance of 9.3 ohms. This is an output of 89.7 watts per pound of copper on armatures. We should be pleased to have Mr. Dobbie point out a long arc machine which will yield "3 or 4 times" this amount, or 269 to 359 watts per pound copper.

Now, as to the incandescent machines built by the same company on the same design, only more iron "is there;" the largest incandescent dynamo that company makes at present will maintain continually, and without undue heating, an E M. F. of 130 volts, and a current of 400 ampères, or a useful output of 52,000 watts. The armature of this machine contains 85 pounds of copper. This is therefore an output of 611.8 watts per pound of copper. We again challenge Mr. Dobbie to point out the "other" incandescent machine "of the same capacity and efficiency" which will give "three or four times" that, or 1,835 *to* 2,447 *watts per pound of copper.*

Lynn, Mass. F. W. Rice, Jr.

Priority in Electric Welding.

To the Editor of The Electrical World:

Sir: I am as much pleased as though the matter concerned myself to see the manful and commonsense manner in which Prof. Elihu Thomson maintains his well-founded claims to the inventorship of electrical welding.

It is one of the most exasperating things that can, and unfortunately, must occur to every one who makes a great and wonderful invention or discovery, to have one and another lift up their voices and pens, and, with one accord, belittle his invention, and in the same breath deny or imply a denial of its originality. And when, time and again, I have seen vague and indefinite claims put forward for prior inventorship of this art, my bile has been stirred, and but that it was no business of mine, and that I knew the perfect ability of Professor Thomson to defend himself, I should have spoken before. When I first read Professor Thomson's account of his invention, given before the Society of Arts in Boston, I thought of another paper read there in 1876, of what the subject of that paper has since become, and of the crop of rivals who have sprung up, like the dragon's teeth sowed by Cadmus, to claim that the telephone was an old story; and that each and every one of them was its first inventor, and I remarked to a friend: "This is new to me, and I am quite sure it is new to the world; but I am also equally sure that inside of a year, if the invention proves to be worth anything, we shall hear of a goodly number of anticipations." And truly so it was.

Inside of a month claimants began to spring up in the electric papers, Messrs. Morris, Weare and Monckton being the last, these indorsed, however, by Mr. Carl Hering.

But Professor Thomson ought to be encouraged. If his invention was not a great and valuable one, there would be nobody rising up and claiming it as their own, or as anybody else's.

It is the same old game, from Watt down to the present time, and until the world is regenerated, so will it always be. It is like the Texas squatter who looks over his neighbor's ranch and seeing a fine horse takes a fancy to it, and wishes it was his; and the next morning *it is his.*

In one of the organ tremolo stop cases, decided by Judge Blatchford, I think, in 1874, his honor concluded his opinion with the following remarkable words, which deserve to be written in letters of gold, and which have frequently since found pertinent application:

"This is one of that class of inventions which, when made, prove to be of such surpassing merit that it is inherently impossible it should have been known before and not have gone into universal use. Its success leads infringers and rival inventors to set up crude and unsuccessful experiments as anticipating it, and dim recollections are stimulated, and conscience is strained to clothe with living flesh what was an inert and useless skeleton."

I am not sure that this is an absolutely correct citation, but it is substantially so. And now a word as to the suggested anticipation. A provisional specification can only, in any event, be regarded as a publication, and it should be, I think, sufficient to call attention to the first article, eighth section and eighth clause of the Constitution of the United States, and to the decided cases, Seymour *v.* Osborne, 11 Wall; Cohn *v.* Corset Co., 93 U. S., 366; Cahill *v.* Brown, 15 O. G., 697, Clifford, J.; Atlantic Giant Powder Co. *v.* Parker, 160 G., 495, Blatchford, J.; Tilghman *v.* Proctor, U. S.; and Howe *v.* Morton, 1 Fish, 594, Sprague, J., to readily determine what kind of a reference is necessary to render invalid an otherwise good United States patent: "The nature and operation of the patented invention must be disclosed in such full and exact terms as to enable the workman therefrom to carry it into practical use."

And the object of our patent law, according to the Constitution, is "to promote the progress of science and useful arts."

Who has done this, Morris, Weare and Monckton or Prof. Elihu Thomson? One gave the world a suggestion of a possibility; the other described in good, plain terms a new art, in such a way that any workman fairly skilled in electrical technology could practice it.

There is no necessity for doubt here.

Boston, Mass. Thos. D. Lockwood.

Incandescent Lamp Switch Patents.

To the Editor of The Electrical World:

Sir: We notice in your issue of April 2d a description and cut of a switch, designed by Mr. Hochhausen for use with glow lamps, having a high resistance shunt coil on magnet, the armature of which when attracted releases a spring contact. We beg to say that we designed and manufactured a similar switch in February, 1886, and that a patent has been allowed us for the same.

Schuyler Electric Manufacturing Co.,
per R. E. Dunston, Factory Manager.

Hartford, Conn., April 6.

"The Gap."

To the Editor of The Electrical World:

Sir: The more words suggested for the space between armature core and field magnet poles, the greater will necessarily be the range of choice.

Let me, therefore, mention one which I ordinarily use in that connection, viz., "the gap."

As the distance between wire and pole-pieces is more of mechanical importance, the word "clearance," already in use, will allow a sufficient distinction.

The continuance of the magnetic circuit in an ordinary two-pole dynamo is effected by the lines of force overbridging two gaps in the magnetic conductivity.

Hartford, Conn. H. L.

Electric Search Lights.—Some important experiments were made by the French ironclad squadron at Toulon. With the aid of a new reflector, torpedoes were visible 4,000 metres distant.

Railway Building by Electric Light.—The Manitoba Railroad has contracted for 610 miles of new track, and the work is to go on night and day, electric light being used for the night work.

Cornell University.—A large number of the "electricals" and other Cornell students have been examining the sights in the electrical business around New York and at adjacent places. They appear to have derived much pleasure and instruction from the trip.

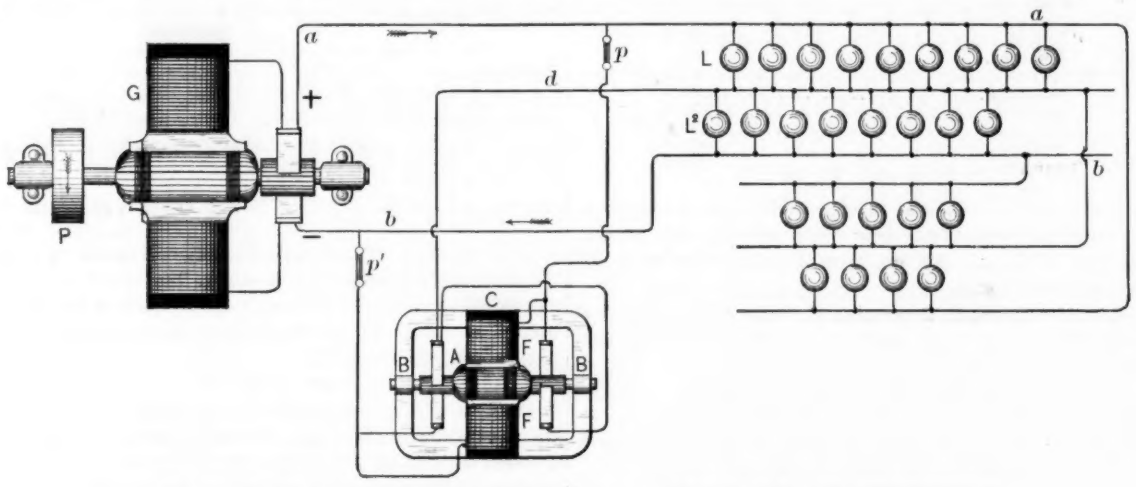
The Latest Suit as to Tickers.—A hearing was given at the Westchester County Court on April 11 by Judge Dykman to determine whether he should make permanent the temporary injunction which restrains the New York Stock Exchange from throwing out the Commercial Telegram tickers now in the Exchange.

Electricity and Paper Making.—Mr. H. J. Rogers, of Watford, England, has invented a strainer for straining paper pulp, the vibrations of the diaphragms of which are actuated by a current of electricity. This will render the strainer perfectly noiseless, which will be a great advantage. The strainer plates are so constructed that no dirt can possibly pass them and reach the paper in course of manufacture.

Hypnotizing by Telephone.—According to the *Zeitschrift für Elektrotechnik*, a M. Jules Liégois has made some successful experiments of hypnotizing by telephone. The first experiment was made upon M. Gordoilet, one of the editors of the *Courrier de Meurthe et Moselle*, through a line about 1,500 metres in length. M. Gordoilet was hypnotized by the distant operator within two or three minutes of placing the telephone to his ear. A lady was subsequently sent into a hypnotic sleep, and further experiments on various persons showed that there was no difficulty in producing all the ordinary hypnotic effects on a distant subject by means of the telephone.

A New Method of Regulation in Three-Wire Distribution.

In the usual method of distribution on the three-wire system, the current furnished by the dynamo passes to the main and then through a group of lamps to a connecting wire, from which it passes through another group of lamps to the other or return main, and thence to the dynamo.



NEW METHOD OF REGULATING THREE-WIRE DISTRIBUTION.

Such a system ordinarily requires that the energy of current or number of lamps be equal for each multiple arc group; that is, that the groups be "balanced;" but where this is not the case, a compensation may be secured by the employment of resistances placed in branch circuit around the group containing the fewest lamps, or in which the smallest current is needed.

In a new arrangement designed by Prof. Elihu Thomson, to effect proper regulation of the current in each group of lamps, the compensation is rendered automatic, and at the same time a transfer of energy is made from the parts of the circuit where it would otherwise be in excess to those parts which require more.

Prof. Thomson accomplishes this by combining with the mains of a multiple-arc series, or three wire system, a converter which permits of the extinguishing of lamps in any multipe-arc group at will, relying upon the compensating apparatus to effect a proper balance.

The manner in which this is accomplished is illustrated in the accompanying diagram. In this, G represents the generating dynamo, which maintains a fairly constant difference of potential between the mains a and b. The potential is sufficient to work two multiple-arc sets of lamps in series, as indicated at L L^2. The intermediate wire d unites the two sets.

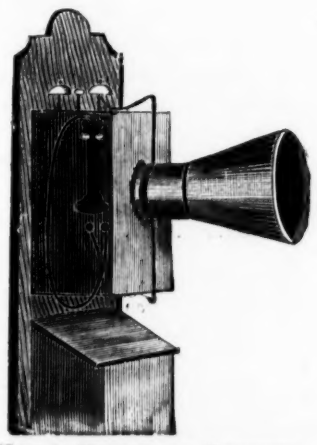
Now, in operating such a system, so long as the number of lamps in L and L^2 be equal, or the current in both is alike, no difficulty will be experienced; but should a change take place, as by the extinction of a part of the lamps in the set L^2, an excess of current will traverse the remaining lamps of the set, increasing their brilliancy, and tending also to decrease the brilliancy of the lamps in group or set L.

Any attempt to adjust matters by changing the potential at the generator G is without avail. To overcome the difficulty Prof. Thomson attaches to the mains a b d what he terms a "compensator" or "converter," for current energy. One of his best arrangements is illustrated at C in the engraving. It consists of a sort of dynamo-generator or motor, or rather a combination of the two. The field-magnets F F are connected, one terminal to a and the other to b, as a shunt to the circuit or branch from a to b of rather high resistance, so as to demand but a very small fraction of the current.

The armature A is wound with a double winding or two separate and insulated sets of coils, which are, however the counterparts of each other in electromotive energy. The armature-windings or sets of coils are each provided with a separate commutator and brushes, shown to the right and left of the armature A. The armature windings are made of quite low resistance and of such length of wire that they will give, respectively, when revolving in the field F F at a high speed, an electromotive force equal to that which normally exists between a and d and between d and b—*i. e.*, the voltage of the lamps used in L and L^2.

The connections are made as shown. If a be the positive wire of G, then b will be negative, and d nearly neutral, when the lamps in L and L^2 are equal in number. A wire is carried from a, through a fusible plug p to one of the brushes of the compensator C, which brush, when the armature A is revolved, will receive a counter-electromotive force from the commutator segments, tending to oppose the potential of a. The opposite brush is connected to d. On the other side, as shown, and at the other commutator a brush is connected to b in like manner, so that when revolved the armature A will give a counter force to oppose the potential of b. The opposite (upper) brush is connected to d. The apparatus and circuits thus arranged will give the following results:

Assuming the demand for current in L and L the same, the potential between a and d will be equal to that existing between d and b. The armature A will receive current at both commutators, tending to short-circuit from a to d and from d to b through each set of coils on it. The result of current passing in A, if the brushes on the commutator be set on the neutral line, will be to drive A as a motor without load, and its speed of rotation will continually increase until the counter potentials developed in its coils almost neutralize the potentials between a and d and d and b, so that little current flows in A, and only enough to keep up the speed of A. Now let some of the lamps L be cut off. The potential between a and d will at once rise and that between d and b will fall, because the resistances are now no



HALL'S TELEPHONE TRUMPET.

longer evenly distributed from a to b. As the resistances of the windings on A are quite low, more current will now pass from a to d through one winding of the compensator-armature A, and it will run faster than before. The device will now act as a generator to give current back to the circuit between d and b by the other winding; or, in other words, it becomes a motor-generator running by the higher potential to feed the main having the lower, and the action will occur with either winding on A, according as the higher potential exists between a and d or between d and b, the higher potential sending current through the motor-generator C and inducing current in the other armature-winding, which is fed out to raise the lower potential. It is essential that the resistances of the windings on A be so low as to be negligible, and that their opposition to passage of current under normal conditions be due to counter-electromotive force solely.

As will be seen, under the conditions outlined above, the apparatus acts as a converter for turning or converting the electric energy or potential existing between one pair of mains into electric energy or potential between another pair, so as to effect an equalization.

As it is usually only necessary to provide for a partial extinction of lamps in either group, the compensator C is small compared to the generator G, and, furthermore, its effectiveness can be enhanced by constructing it to run at very high speeds, as it requires no belts and there is no strain on its bearings.

A New Engine for Electric Lighting Purposes.

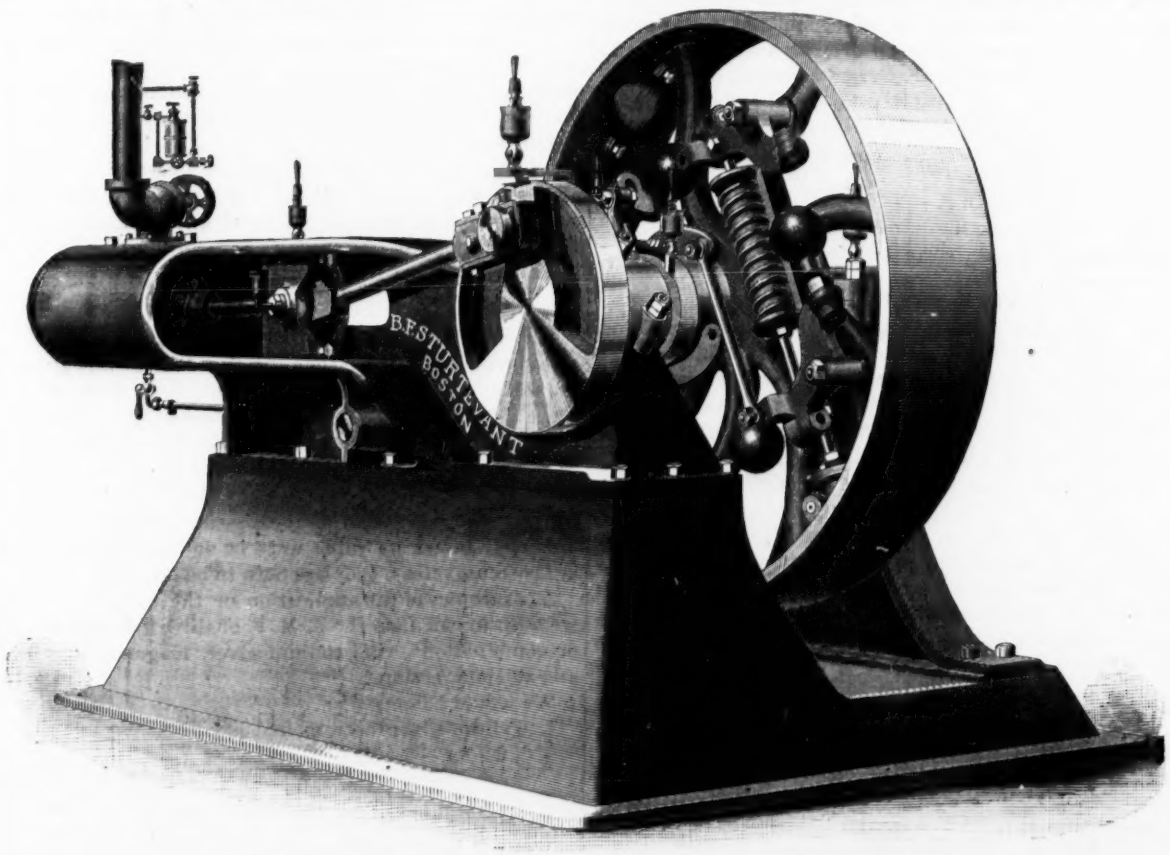
The cut herewith represents a new automatic cut-off engine, designed and manufactured by B. F. Sturtevant, of Boston, Mass., the well-known manufacturer of the celebrated blowers and exhausters. This engine possesses many valuable features which give it prominence among small engines adapted for driving dynamos and other machinery where it is necessary to maintain a uniform speed regardless of the load, and where it is desired to use steam economically. The governor is contained within the band wheel, and is admirably designed for weighing the load. It is very sensitive, with a range of cut-off from zero to seven-eighths, maintaining a uniform speed at all times regardless of the variation of the load. Among the important features of this engine are the perfectly balanced piston valve, straight steam ports, with large area, careful distribution of weight in the reciprocating and revolving parts and overhanging cylinder, and a frame with the metal properly distributed on the lines of strain. The engine is provided with ample bearing surfaces, and superior oiling devices, thus guaranteeing cool bearings at high speeds. The self-contained bed of this engine producing a natural positive alignment of parts, is another important and valuable detail which will be appreciated.

Hall's Telephone Trumpet.

Among the numerous devices designed to be attached to telephone transmitters in order to increase the volume of sound is the Hall "telephone trumpet," shown in the accompanying illustration. The device consists of an outer copper cone, within which is placed another of smaller diameter, with its small end directed outwardly. We have talked through the instrument frequently, having one in our offices, and find considerable and marked improvement in the loudness of the sound. Mr. S. Nelke, of this city, is the agent for the sale of the "trumpet."

Western Union Stock.

A special meeting of the stockholders of the Western Union Company was held on April 12, when two important resolutions were ratified, having been previously adopted by the directors on March 9. The first of these is to increase the capital stock 12,000 shares, or $1,200,000, for which amount a scrip dividend was issued on the 15th of April, last year, payable in the capital stock of the company within twelve months, or when the company shall have obtained authority to increase its capital stock. It is proposed to increase the capital stock the exact amount of the scrip certificates outstanding, and issue it for the sole purpose of their redemption.



NEW ENGINE FOR SMALL ELECTRIC LIGHT PLANTS.

The other resolution is to authorize the issue of bonds having 50 years to run and bearing interest at a rate not exceeding 5 per cent., in exchange for the bonds and stocks of companies whose lines have been leased to the company, on which stocks and bonds the company is paying rental in the form of interest or dividends, the exchange to be made on a basis that shall save to this company not less than one-sixth of the amount of rental now being paid in any case. Substantially, it is proposed to give a 5 per cent. bond in lieu of a 6 per cent. security under existing contracts of lease.

Calculation of the Electromotive Force of Batteries

BY DONATO TOMMASI SC. D., PARIS.

In order to calculate the E. M. F. of batteries by reference to the heat units of combination involved in each case, the numerical relationship between certain thermic data should first be understood. This relationship was defined some years ago by the writer, by the enunciation of the *law of thermic constants*, which law may be stated as follows :

"*When a metal replaces another metal in a saline solution, the number of calories or heat units set free is always the same for each metal, no matter what may be the nature of the acid radical entering into the composition of the salt.*"

Zinc, for instance, when it replaces copper in a solution of sulphate of copper, evolves 50.6 calories (1 calorie= 3.968 British heat units) : and the substitution of zinc for copper, in any soluble cupric compound whatever, will always set free the same amount of heat. If cadmium were to be used instead of zinc, there would be 33.8 calories set free, but the amount would be the same for all salts of copper. It would be the same in the case of all metals which can replace each other, not only in a cupric solution, but in any saline solution.

On the other hand, it is known from the principles of thermo-chemistry that the number of calories set free by zinc replacing copper in sulphate of copper, is equal to the difference between the heats of combination of sulphate of zinc and of sulphate of copper,

$$(SO_4\,Cu + Zn = SO_4\,Zn + Cu\ ;\ 50.6 \text{ calories}) \text{ or}$$
$$= (\partial\,SO_4\,Zn - \partial SO_4\,Cu = 50.6 \text{ calories})$$

where the symbol ∂ placed before each salt indicates that the heat of combination of that salt is to be taken.

From the principles which I have just set forth, it must follow, that if the difference of the heats of combination of sulphate of zinc and sulphate of copper is equal to 50.6 calories, this number will also represent the difference of the heats of combination of zinc chloride and copper chloride, zinc bromide and copper bromide, zinc acetate and copper acetate, etc. As a rule, if we designate the acid radicals by R, R', R'',. . . ., and the metals by M, $M,'$ M'', . . ., we will have

$$\partial\,R\,M - \partial\,R\,M' = \partial\,R'\,M - \partial\,R'\,M'.$$

Starting from these considerations, I have succeeded in working out a table, by means of which it is possible to determine *à priori* the heats of combination of all mineral and organic *soluble salts*. I have prepared this table by taking the heat of combination of potassium chloride in solution and subtracting therefrom the heats of combination of other chlorides, also in solution. Thus the value 88.8 cal., found in the table given below, expresses the difference of the heats of combination of potassium and zinc :

$$2 \times \partial\,Cl\,K - \partial\,Cl_2\,Zn = \vartheta\,Zn,$$

where ϑ indicates the thermic constant.

The value 4.6 cal., corresponding to sodium, expresses the difference :

$$\partial\,Cl\,K - \partial\,Cl\,Na = \vartheta\,Na.$$

The same table could also have been prepared by taking the difference between the heats of combination of the bromides, the iodides, the sulphates, etc., of potassium, and the bromides, iodides, sulphates, etc., of other metals.

TABLE OF THE THERMIC CONSTANTS OF SUBSTITUTION.

General formula : $\Delta = \delta \pm \vartheta$.

Where Δ = The salt whose heat of combination is to be obtained.

δ = The heat of combination of a potassium salt having the same acid radical as the salt Δ.

ϑ = The thermic constant corresponding to the base of the salt.

Value of ϑ with Reference to the Molecular Weights of the Dissolved Salts.

($H_2\,O = 18$.)

Salts of	Lithium	−1.1	Calories.
"	Sodium	+4.6	"
"	Silver	87.4	"
"	Thallium	62.3	"
"	Magnesium	14.6	"
"	Barium	$136.2 - x$	"
"	Strontium	6.0	"
"	Calcium	14.0	"
"	Zinc	88.8	"
"	Cadmium	105 4	"
"	Aluminium	43.3	"
"	" sometimes 3 × 43.3	= 129.9	"
"	Manganese	73.6	"
"	Iron (proto-salt or ferrous)	101.6	"
"	" (per-salt or ferric)	116.4	"
"	" " sometimes 3 × 116.4	= 349.2	"
"	Nickel	108.0	"
"	Cobalt	106.8	"
"	Copper	139.0	"
"	Mercury	142.0	"
"	Lead	123.2	"
"	Tin (stannic)	120.4	"
"	" (stannous)	44.2	"
"	Gold	147.0	"
"	Ammonium	28.1	"

The value given for barium comprises the heat of combination of barium with the oxygen, which value (x) has not yet been determined.

Heats (Calories) of Combination of the Principal Potassic Salts, taken in Solutions.

($H_2\,O = 18$)

Potassium	Fluoride	91.4	Calories.
"	Chloride	100.8	"
"	Bromide	91.0	"
"	Iodide	74.7	"
"	Cyanide	64.7	"
"	Perchlorate	96.4	"
"	Iodate	96.8	"
"	Nitrate	96.1	"
"	Nitrite	91.4	"
"	Sulphate	196.0	"
"	Sulphite	196.4	"
"	Chromate	189.2	"
"	Bichromate	191.4	"
"	Acetate	95.6	"

Etc., Etc., Etc.

A few examples taken at random will serve to demonstrate the exactness of the law cited above, and at the same time will show the manner of using the table of thermic constants.

Let it be required to determine the heat of combination of sulphate of copper, in solution. From the general formula we would have

$$\partial\,SO_4\,Cu = \partial\,SO_4\,K_2 - \vartheta\,Cu.$$

From the table of heats of potassic salts we find $\partial\,(SO_4K_2) = 196.0$; the table of thermic constants gives $\vartheta\,Cu = 139.0$; therefore, the difference, or

$\partial\,(SO_4Cu) = 57.0$; while the value found by actual experiment = 56.8.

For the heat of combination of cadmium nitrate we would have

$$\partial\,(NO_3)_2Cd = 2 \times \partial\,NO_3K - \vartheta\,Cd.$$

The tables give us

$2 \times NO_3K = 2 \times 96.1 = 192.2$

$\vartheta\,Cd = 105.4$

Therefore, $\partial\,(NO_3)_2Cd = 86.8$

Actual experiment gives = 86.6

For the heat of combination of iodide of calcium we would have

$$\partial\,I_2\,Ca = 2 \times \partial\,I\,K - \vartheta\,Ca.$$

Referring again to the tables we find

$2 \times \partial\,I\,K = 2 \times 74.7 = 149.4$

$\vartheta\,Ca = 14.0$

Therefore $\partial\,I_2\,Ca = 135.4$, which is exactly the same value as found by direct experiment.

These examples could be multiplied, but the accuracy of the principles is sufficiently established. By making use of my general formula, and by following the method indicated, it will be possible to compare the results of experiments, or to determine beforehand the heats of combination of *all* soluble salts.

I shall now proceed to show how this law of thermic constants applies to the calculation of the electromotive force of batteries. First with respect to batteries containing two liquids.

When a battery is formed of two metals, each immersed separately in a solution of some one of its own salts, and when these salts have the same acid radical or the same halogen in their composition, the electromotive force of the couple is equal to the difference of the thermic constants of these metals divided by the number of calories corresponding to one volt.

Designating by E the electromotive force of a battery of this description ; by ϑ, ϑ', the thermic constants of the two metals ; and by V the value of one volt in calories, these relations can be expressed as follows :

$$E = \frac{\vartheta - \vartheta'}{V}$$

The volt (V) corresponds to 46.3 calories.

It should be observed that the first four metals given in the table of thermic constants are univalent, while the rest are all bivalent. The constants ϑ and ϑ', therefore, refer to metals of either of these two kinds, for the two metals used in a battery may both be monads or diads, or else there may be one of each kind. Therefore, in the above formula, whenever one of the constants ϑ or ϑ' refers to a univalent metal, its value must be doubled; and if they are both univalent, they are both to be doubled.

As examples of the application of the formula, suppose we wish to calculate the E. M. F. of three different couples or combinations, viz., sodium-silver, magnesium-sodium, and zinc-magnesium.

We would have :

1. Sodium-silver (both monads).

$$E = \frac{2\,\vartheta\,Ag - 2\,\vartheta\,Na}{V} = \frac{2 \times 87.4 - 2 \times 4.6}{46.3} = 3.57 \text{ volts.}$$

2. Magnesium-sodium (one diad, one monad).

$$E = \frac{\vartheta\,Mg - 2\,\vartheta\,Na}{V} = \frac{14.6 - 2 \times 4.6}{46.3} = 0.12 \text{ volt.}$$

3. Zinc-magnesium (both diads).

$$E = \frac{\vartheta\,Zn - \vartheta\,Mg}{V} = \frac{88.8 - 14.6}{46.3} = 1.60 \text{ volts.}$$

Of the two metals, that whose thermic constant is the lower constitutes the negative pole of the cell (electro-positive element), and it is also that which will dissolve, while the other constitutes the positive pole (electro-negative element) and receives a deposit resulting from the decomposition of its salt in the solution.

It follows from the preceding law that : *The E. M. F. of any battery formed of two metals remains constant, no matter what may be the acid or the halogen of their salts taking part in the reactions.*

Thus, for example, with a cadmium-zinc couple, the E. M. F. will always be,

$$E = \frac{105.4 - 88.8}{46.3} = 0.36 \text{ volts,}$$

whether the salts employed be sulphates, chlorides, acetates, etc. The general formula for the E. M. F. of any couple composed of two metals, A and B, is therefore :

$$E = \frac{\vartheta\,A - \vartheta\,B}{V} = x \text{ volts.}$$

I will now apply this formula to the case of a battery whose E. M. F. is well known from experiment, *i. e.*, the Daniell battery. From what has just been said, the E. M. F. of this battery will be :

$$E = \frac{\vartheta\,Cu - \vartheta\,Zn}{V} = \frac{139.0 - 88.8}{46.3} = 1\,084 \text{ volts.}$$

If the E. M. F. of the same Daniell cell is calculated by the ordinary method, that is to say, by reference to the electro-chemical equivalents, the procedure is the following : The nature of the reactions produced in the cell being known, the formula

$$E = 4.16\,g\,H$$

is used, in which g is the electro-chemical equivalent of the substance set free from the electrolyte; H being the amount of heat in calories (gramme degrees) set free per gramme of that substance in assuming the state of chemical combination in the electrolyte.

In the Daniell battery, two distinct actions are produced, viz., zinc is dissolved in the sulphuric acid, and copper is deposited by the decomposition of the sulphate of copper. By the former, heat is set free, while by the latter heat is absorbed ; and the E. M. F. of the cell is equal to the difference between these two actions.

Thus for zinc, where $H = 1670$ calories, and $g = .0003412$, we would have

$$E_d = 4.16 \times .0003412 \times 1670 = 2.37 \text{ volts.}$$

For copper, $H = 881$ calories, and $g = .0003307$, so that we have

$$E_a = 4.16 \times .0003307 \times 881 = 1.21 \text{ volts.}$$

The E. M. F of the Daniell cell is therefore :

$$E = E_d - E_a = 2.37 - 1.21 = 1.16 \text{ volts.}$$

It will be seen that this method is far from being as simple and quick as that which I have deduced from the law of thermic constants ; and it is easy to see at the same time that its results are not as accurate. As a matter of fact, the accepted figure, in practice, for the E M. F. of the Daniell cell is 1.079 volts. If we compare this value with those obtained theoretically by both the above methods, it will be found that the result given by the method of electro-chemical equivalents is 7.5 per cent. too high, while the result given by the method of thermic constants is only .46 per cent. above the experimental value.

I will now show how the E. M. F. of single liquid batteries is to be calculated.

When a battery contains only one liquid, its E. M. F. is equal to the difference between the thermic constant of the metal which is attacked and that of the hydrogen set free, divided by the value of the volt in calories.

The thermic constant of hydrogen is equal to 61.5 calories. This value has been obtained, as in the case of all the other thermic constants, by subtracting the heat of combination of hydric chloride or chlorhydric acid in solution, from the heat of combination of potassium chloride, also in solution. If we represent by ∂ the heats of combination of these compounds, we will have for the thermic constant or ϑ of hydrogen,

$$\partial\,Cl\,K - \partial\,Cl\,H = \vartheta\,H.$$

Replacing these symbols by their numerical values, we have :

$$100.8 - 39.3 = 61.5 \text{ calories.}$$

Suppose, now, that the E. M. F. of a zinc-copper couple in dilute sulphuric acid is to be determined. The general formula would give :

$$E = \frac{2 \times \vartheta\,H - \vartheta\,Zn}{V} = \frac{2 \times 61.5 - 88.8}{46.3} = 0.7386 \text{ volt.}$$

The E. M. F. of this same couple is found by direct experiment to be equal to .81 volt. If the result found experimentally is somewhat higher than that obtained theoretically, it is because the hydrogen evolved during the decomposition of the $H_2\,SO_4$ (and not of $H_2\,O$, as generally supposed) is partly absorbed by the copper, setting free some heat which is transformed into electrical energy that adds to the primal E. M. F. of the couple. As a matter of fact, the E. M. F. of the zinc-copper couple with dilute sulphuric acid, not only varies with the nature of the inactive metal (copper), but also with its physical state. That explains why the E. M. F. of this couple has not been found the same by the various experimenters who have made determinations of it.

Zinc-copper couple, dilute H_2SO_4		.81 Poggendorff.
" " " " "	maximum cell	.940 Reynier.
" " " " "	minimum "	.193 "
Same with zinc amalgamated		.94 Poggendorff.
" " " "	maximum cell	1.072 Reynier.
" " " "	minimum cell	.272 "

M. Reynier obtained these two extreme values by means of two types of cell specially arranged for the purpose, and called by him the cell for maximum E. M. F., and the cell for minimum E. M. F. The former has a positive electrode of 300 times the surface of the negative. The latter, on the contrary, has a positive electrode of very small surface compared with the negative, and its E. M. F. is measured after the cell has been short-circuited a long

time. This method is, in my opinion, rather defective; however, I shall not now dwell on it, but I shall return to the subject under consideration.

As a rule, the E. M. F. of a given couple ($M - M'$) is the higher, the greater the quantity of hydrogen absorbed by the inactive metal. This fact is readily shown by reference to the following table. The couple is

$$(Zn - M) + H_2 SO_4, Aq.$$

Zinc — Copper	.94	volt.
" Silver	1.24	"
" Carbon	1.26	"
" Platinum	1.44	"

It is proper to observe that the value given for the E. M. F. of the zinc-platinum couple is not exact, since it results from my own experiments that this E. M. F. is much lower than that of the zinc-carbon couple. This fact, which I was the first to observe, has since been corroborated by M. Berthelot and others.

It follows, from the principle set forth above, that:

The E. M. F. of a single liquid battery is the same, *whatever may be the nature of the acid employed, and that it depends only on the oxidizable metal.*

There is an exception to this rule in the case of those acids which can be reduced by hydrogen, or, to be more precise, by hydrogen and heat, such as, for example, chromic acid, nitric acid, etc. These reactions are sometimes explained by presuming the hydrogen to be in a certain special, I might say almost mysterious, state, called the *nascent state*. I showed in 1878, however, that hydrogen, the moment it has parted from a given combination, does not possess reducing properties because of its "nascent state," but simply owing to the amount of heat which is evolved at the time it leaves the combination.

To show the exactness of the principle just set forth, I will take a few examples. Let me remark here, however, that the E. M. F. of a single liquid battery is obtained by taking the difference between the heat of combination of the salt and that of the acid, instead of the water (as is often done erroneously), the result being divided by the value of the volt in calories.

For the couple—

$$(Zn - M) + H_2 SO_4, Aq,$$

we would have—

$$E = \frac{\partial SO_4 Zn - \partial So_4 H_2}{V}.$$

The heat of combination of sulphuric acid, or, more properly, of $H_2 + SO_4$, is, from the law, equal to 73.0 calories, and that of zinc sulphate to 107.2; consequently we have:

$$E = \frac{107.2 - 73.0}{46.3} = 0.7386 \text{ volt.}$$

The heat of combination of the other acids, or more properly, the heat of combination of hydrogen with the halogens, or the acid radicals, is obtained in accordance with the law of thermic constants, by subtracting from the heat (calories) of combination of the soluble salts of potassium, the thermic constant of hydrogen, or 61.5 calories. Thus the heat of combination of $H + SO_4$ in solution is equal to

$$\partial SO_4K_2 - 2 \times \eth H = \partial SO_4 + H_2;$$
$$19.0 - 2 \times 61.5 = 79.0 \text{ calories.}$$

The heat of combination of bromhydric (or hydrobromic) acid, is:

$$\partial Br K - \eth H = 31 - 61.5 = -27.5 \text{ calories.}$$

The other acids have the following heats of combination:

HEATS OF COMBINATION OF THE PRINCIPAL ACIDS IN THE STATE OF SOLUTION.

$(R + H) + Aq$, or $(R'' + H_2) + Aq$;
where R is a monad acid radical or halogen,
and R'' is a diad " " "

NAME OF ACID.	Heat formula.	Calories. Calculated from law of constants.	Calories. Found by Berthelot and Thomsen.
Hydrochloric	$Cl + H$	39.3	39.3
Hydrobromic	$Br + H$	29.5	29.5
Hydriodic	$I + H$	13.2	Not yet determined.
Perchloric	$ClO_4 + H$	35.9	"
Sulphuric	$SO_4 + H_2$	73.0	"
Chromic	$CrO_4 + H_2$	66.2	"
Acetic	$C_2H_3O_2 + H$	34.1	"
Oxalic	$(C_2O_4)'' + H_2$	70.2	"

It remains for me to demonstrate that a given voltaic couple has always the same E. M. F. in any acid, with the exception of acids reduced by hydrogen, as already remarked. Let us take as our example the magnesium-platinum couple, excited with various acid solutions. Neglecting the effects of polarization, the electro-motive forces will be as follows, for each particular acid:

1. $(Mg - M) + S O_4 H_2, Aq$;

$$\partial S O_4 Mg - \partial S O_4 H_2 = \frac{181.4 - 73.0}{46.3} = 2.341 \text{ volts.}$$

2. $(Mg - M) + 2 Cl H, Aq$;

$$\partial Cl_2 Mg - 2 \times \partial Cl H = \frac{187.0 - 2 \times 39.3}{46.3} = 2.341 \text{ volts.}$$

3. $(Mg - M) + 2 C_2 H_4 O_2$;

$$\partial (C_2 H_3 O_2)_2 Mg, 2 \times \partial C_2 H_4 O_2 =$$
$$\frac{176.6 - 2 \times 34\ 12}{46.3} = 2.341 \text{ volts.}$$

It is seen from these cases that the E. M. F. of the magnesium-platinum couple remains the same, no matter what may be the exciting acid solution.

If we had taken zinc instead of magnesium we would have obtained a different E. M. F., but this value would again remain the same for any acids used in the exciting solution. Thus we would have:

1. $(Zn - M) + SO_4 H_2, Aq$;

$$\partial SO_4 Zn - \partial SO_4 H_2 = \frac{107.2 - 73.0}{46.3} = 0.7386 \text{ volt.}$$

2. $(Zn - M) + 2 \times Cl H, Aq$;

$$\partial Cl_2 Zn - 2 \times \partial Cl H = \frac{112.8 - 2 \times 39.3}{46.3} = 0.7386 \text{ volt.}$$

3. $(Zn - M) + 2 \times C_2 H_4 O_2, Aq$;

$$\partial (C_2 H_3 O_2)_2 Zn - 2 \times \partial C_2 H_4 O_2 =$$
$$\frac{102.4 - 2 \times 34.1}{46.3} = 0.7386 \text{ volt.}$$

I must observe that these results would no longer be exact if the inactive (electro-negative) metal were attacked by the liquid; such would be the case for instance with the zinc-copper couple, zinc-aluminium couple, etc., when used in solutions of hydrochloric acid, hydrobromic acid, etc.

The Electric Current as a Fixture.

The adaptability of the common law to novel circumstances was well illustrated in Fechet v. Drake, decided by the Supreme Court of Arizona a few weeks since. The owner of land, the premises formerly of an electric lighting company, claiming under a mortgage, brought suit to quiet his title. The adverse claim he sought to extinguish was that of the assignee of the mortgagor, who was advised that the wires in the air were personal property and not bound by the mortgage. The terms of the mortgage included the engine, dynamo and "appurtenances."

The Court say: The later, and we think the better, doctrine does not require an actual fastening to the soil as essential to making a chattel a fixture. The third rule stated by Mr. Carpenter (2 Wall, 646) is sustained by these authorities: "If the thing be essential to the use of the real estate, and has uniformly been used with it, then it passes, though not fastened to it" (Farrar v. Stackpole, 6 Greenl., 157; Snedeker v. Warring, 12 N. Y., 170; Pierce v. Emery, 32 N. H, 484; Minnesota Co. v. St. Paul Co., supra; Railroad Co, v. Thompson, 103 Ill., 209). The electric current, including wires, poles, insulators and appliances, was an essential part of the machine. To sever it was to destroy it. The object of the law is to preserve and not to destroy. A machine made of many parts, operated for a useful purpose, may have great value. Sever the parts, and they are each comparatively worthless. And it is the duty of the courts, so far as may be, to so construe the law that the usefulness and value of such property be maintained. In Regina v. North Staffordshire Railway Company (3 El. and El. 392), Lord Cockburn held that telegraph apparatus, consisting of posts driven into the ground and wires passing through sockets annexed to the posts, but which wires might be disconnected from the posts without injury, or displacing them, were a part of the appliances of the defendant railway company, and were fixtures, as they were so attached that it was intended that they should remain permanently connected with the railway, or the premises used with it, and remain permanent appendages to it as essential to its operation. Such is this case. We have so far considered this as though it were an ordinary conveyance of the lot, but the mortgage conveyed the lot, "together with all the machinery, including the boiler, engine and dynamo now situated on said lot, and together with all and singular the tenements, hereditaments and appurtenances thereto belonging or in anywise appertaining." In Pickerell v. Carson (8 Iowa, 544), a sale of fixtures and appurtenances contained in the daguerreian rooms," etc., embraced all such property as was used in carrying on the business, such as maps, pictures, stove, carpet, apparatus and furniture, machines and stock, as appurtenances, and skylight, balcony, partition, etc., as fixtures. The electric current is, then, an appurtenance to the machinery situated on that lot, and is therefore covered by the language of the mortgage, even if not a fixture. Extra rolls in a rolling mill, removable at pleasure, were held to be a part of the realty as appurtenant to it, Pyle v. Pennock (2 Watts & S., 390). A statue and a sun-dial also. (Snedeker v. Warring, 12 N. Y., 170; Wadleigh v. Janvrin, 41 N. H., 503.) A mortgage of a railway, with its appurtenances and franchises, includes its rolling stock, tools and all movable property used in its operation. (Railroad Co. v. Thompson, supra.) The ingenuity of invention, creating new appliances for usefulness, constantly brings new facts for the consideration of the courts; and to these established principles must be applied. To determine whether a particular chattel has become a "fixture" or an "appurtenance" we must be guided by authority. A consideration of the authorities leads to the conclusion that in each case it is a mixed question of law and fact, largely to be determined by the intention of the parties, and the uses to which the chattel is devoted. In this case it was the evident intention of the parties to make this electric current a part of the machine mortgaged and attached to the land—to become a part of the realty. We hold, therefore, that the chattel so attached passed with the mortgage.—12 *Pacific Rep.*, 697.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, April 11, 1887.

Mott Haven, and, for that matter, the upper part of New York beyond the Harlem Bridge, is becoming quite active as a centre for the production of electrical apparatus. At Mott Haven Messrs. R. Edwards & Co. have an entirely new factory equipped throughout with the latest improved machinery. Here they make their special door-openers, a sample of which should be in every supply house and contractor's office; burglar alarms and annunciators, in which line they present some handsome and novel designs, with clock attachment and electric light for night service. In case of alarm, the light will show the time and indicate the locality of the intruder. The iron box bell made by the firm incloses the works entirely, leaving no opening for dust or insects, and is entirely different from anything of the kind before presented. Electric gas-lighting appliances constitute another department of the firm's work. A variety of these goods can be seen at 171 Broadway. The firm stand ready to fit up office, store or factory, with everything electrical.

Mr. D. Rousseau, who was one of the pioneer manufacturers to invade upper Northern New York has now completed his new factory, and has sanguine expectations of fitting up most of the new houses in the city and around him with his various electrical specialties. He is now busy meeting the wants of some of the supply houses for bells, etc.

The Waterhouse Electric Light Company are, I notice, increasing their plant quite extensively in Westchester, and are already reaping the reward of their farsighted enterprise. There is lots of room for electric light in the locality. The Harlem Bridge lighting, by the way, is quite a commendable curiosity. When crossing the bridge at the time I gathered these notes. I was somewhat puzzled to detect just how the current was fed to the lamps when the bridge was swinging. I found that they have the wires run up on the central upright shaft which goes to the engine room right above the middle of the bridge. There is a large arc light on the roof affording brilliant illumination.

Mr. Thomas Farrell, 2257 Third avenue, has been increasing his factory room to meet the demand for his productions in the shape of household electrical specialties.

I might mention here that while I was uptown I saw at the foot of 150th street and Harlem River the Jukes Glass Factory idle and going to decay. It is a good location and now is the time for an energetic and live electrical concern to step in. The advantage of having water communication so near the city proper and Brooklyn is not to be despised.

I notice that the papers report a suit by a Mr. W. S. Wilkinson, of Baltimore, against Mr. W. O. Callender and the Callender Insulating & Waterproofing Company for $75,000, for commission and stock. The company denies any such contract, and I understand that Mr. W. O. Callender has a suit against Mr. Wilkinson. Mr. W. L. Callender, of the Callender Company, is in a very happy frame of mind over the activity in business. The Newark factory is busy night and day, and the month's orders amount to over $65,000.

Mr. M. Sullivan, 125th street and Ninth avenue, reports himself as very active putting out his new door opener, for which he finds a brisk demand.

Mr. George H. Pride has received the appointment of electrician in the new Equitable Life Insurance building, 120 Broadway, of whose United States lighting outfit I made note recently. Mr. Pride, I observe, is not concealing the wires in the plaster as heretofore in the building, but is running them in wooden cornices around the walls, making it more convenient to get at them for any purpose. There is no public building in the world that has an electrical equipment to compare with that in the Equitable building. In the Safe Deposit vaults alone there are thousands of dollars worth of apparatus, including a number of watchmen's clocks, indicators, alarms, call systems and the like.

Hazazer & Stanley, 32-4 Frankfort street, are actively engaged filling a number of orders. They report having received several good inquiries for large annunciators as the result of an illustrated description of one of their latest devices in that line in a late number of THE ELECTRICAL WORLD.

The United States Electric Engineering Company, of Brooklyn and this city, are offering a new copper battery with porous cup and zinc, etc. They claim to have run 4 of the batteries for 24 hours on closed circuit with 4 volts, and 1 ampère at the beginning and at the close with a constant 3 volts and 1 ampère. The outside jar is of copper, and, as I understand, will, practically, never deteriorate. It has a sealed top similar to the ordinary porous cup battery. The company have several orders for their new dynamo, and will have in some 150-light machines this week. They have, I believe, already received an order for a large city plant, to be fitted up shortly. The firm are now Brooklyn agents for the Culp electric gas-lighter, which they are going to push.

The American Manufacturing and Supply Company (Limited), 12 Dey street, N. Y., have contracted with the Self-Winding Clock Company, 17 Dey street, N. Y., to purchase their entire production of individual regulators, chronometers, mantel clocks, etc. C. H. Pond & Co., of 17 Dey street, will retain control of their synchronous system of furnishing time to secondary clocks for cities, towns, etc.

Mr. Horace Van Sands, electrical supplies, 733 Broadway, issues a neat little pamphlet on "Electrical Appliances," in which he describes bells, alarms, etc., and gives a number of useful points as to construction work. It is, in fact, a practical manual by one who is himself thoroughly well informed on the subject.

The New York and Brooklyn Bridge arch in York street, Brooklyn, has been leased by the Clayton Air Compressor Works, of 43 Dey street, New York, for use as a warehouse for the storage of their stock of air compressors, vacuum pumps for electric light works, etc., as the pressure of orders at their works requires all the available floor space.

I have made note recently on more than one occasion of the efforts tending to a combination among the carbon producing interests. Up to the present time there has not been much that could be published, but I am now at liberty to enter a little into details. The plan of combination was practically decided upon some little while ago, as announced in these columns, and it has

been carried through in its present shape by Mr. E. C. Hawks, of the Buffalo Electrical Works, who will be the trustee and general manager for the "combine," and will have his offices in Cleveland. Among those who are interested in the enterprise are said to be some Standard oil men, who expect to control the output of the chief material for making the carbons, *i. e.*, the residuum of oil, from the great refineries. There is, I believe, only one company that uses gas residuum—the Solar Carbon Company. The following companies have given in their adhesion to the plan; National, Boulton, Cleveland and Crystal Carbon companies, all of Cleveland; American and Parker-Russell, of St. Louis; Empire and Solar, of Pittsburgh; Richmond, of North Adams, Mass. The Forest City Carbon Company of Cleveland is not in the "combine," but is desirous of its success. The "combine" is to be conducted, I understand, on a percentage basis, and ought to do good to carbon producers, though its effect is likely to be hard on small companies that have short contracts for cheap carbons, and long contracts for cheap lighting. The combine is, in fact, a natural reaction from the cutting in prices that has prevailed in the past, and which was ruinous too, as some manufacturers could not stand it.

The position of the Brush Company is not antagonistic to that of the combine, but, as your Western representative so clearly pointed out last week, is one favoring higher prices. As a supplement to his letter, I may as well here quote the circular he spoke of.

"On and after April 1, 1887, the following prices will be charged for Brush copper-coated carbons:

7/16 inch	$25.00 per 1,000
1/4 inch	31.25 "
5/8 inch	43.75 "

less .... per cent. discount

"We propose to make but one grade of carbons, and shall endeavor to make the quality as nearly perfect as possible. This increase in our prices of carbons is small, and the principal change, so far as our customers are concerned, is in the confining of our output to one grade. A large part of our customers have been led recently to use our former grade of "seconds" carbons largely or wholly in their lamps on account of their low price, and this has resulted in very many cases in a lowering of the quality of the light furnished and led to frequent interruptions in the service. With our above quoted carbons and the requisite care in other parts of the service, the Brush light should be superior to all others in all the qualities demanded by the business of electric lighting. We are informed that the other carbon factories in the country have come to an agreement among themselves and have stopped the war in prices, which has been waged with such fury and loss. In order to enable you to adjust your orders for carbons to the new basis, we shall continue to fill your standing orders, already on our books, with the carbons ordered and at the old prices, until April 15, but we will fill all new orders received after April 1 at the new prices."

Of course the combine is viewed in various lights, depending largely on the interests of the person speaking of it. I have heard some praise it, others condemn, and yet others predict that it will give an impetus to the establishment of new and independent carbon factories. I might add that one well-known company not named above is said to have disposed of its plant to the combination.

There is a good deal of curiosity as to the personnel and purposes of the East River Electric Light Company, which has been offering to do electric light work for the city. It has a capital stock of $30,000, and Mr. S. C. Smith is president; Mr. J. Carroll, secretary; and Mr. E. Duffy, treasurer. Mr. Smith hails from Plainfield, N. J., and it is not to be overlooked that Plainfield is an interesting place, electrically speaking, just now. Of course Mr. Maurice B. Flynn is credited with having an interest in the company.

Mr. E. H. Goff is active and enterprising as usual. On April 4 papers transferring the American and foreign patents, stocks in local companies, machinery and other property of the Fuller-Wood Electrical Company to the American Electric Manufacturing Company were executed. The former owned the original Gramme and Fuller-Wood patents, and the purchasing company now controls both. For some time past the American Company has been paying the Fuller-Wood Company royalties on the patents of about $40,000 a year. It is estimated that, with the rapid extension of the business of the American Company, it would have soon run to $60,000 and over per annum; or, computing interest at 6 per cent. per annum, this sum would have reached about $2,000,000 before the term ran out. This purchase ends all payments of royalties by the American Company. The papers were signed by William W. Appleton, as president of the Fuller-Wood Company, and E. H. Goff, as president of the American Electric Manufacturing Company. This transfer adds a new element of financial strength to the American Company, which will be of great advantage to it in its future business. Mr. Goff is now in Chicago, where he has in progress, it is said, some very important negotiations looking to the consolidation and development of gas and electric lighting interests there.

The New York *Sun* of April 10 contains an interesting article on the cables between this country and Europe, placing the capital invested in the ten cables at approximately $72,000,000. It says that more messages are sent to Europe than come westward.

The Jersey City Pottery is turning out one of the best lines of porous cups for primary batteries in the world. The pottery has been in existence over 60 years, and its continued prosperity is an absolute guarantee to the customer that the product is first-class. The pottery makes porous cups for the leading manufacturers of open and closed circuit batteries, and has facilities that enable it to meet any demand for special quantity, size, design or porosity.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Boston, April 12, 1887.

Mr. C. H. Page, of the well-known firm of electricians, Worcester, Mass., favored this office with a visit one day last week.

Mr. Thomas Kirwan, of the Boston *Herald*, has written a biography of Mr. Edwards H. Goff, the President of the American Electric Illuminating Company. It is very well done, and gives an admirable idea of Mr. Goff's career.

Mr. Thomas J. Young, formerly superintendent of sewers in Boston, has been employed by the New England Telephone and Telegraph Company as engineer.

Prof. Charles R. Cross, of the Mass. Institute of Technology, Boston, had charge of the electrical students who have been enjoying a week's tour of inspection to places of interest—principally electrical—in New York.

The E. Howard Watch & Clock Company of Boston has just filled an order for the Pacific Mills, Lawrence, Mass., and an order for the Amoskeag Company, Manchester, N. H. For the former six electric watch clocks, having a total of 69 stations, have been installed; and the mills of the latter have been fitted up with fourteen electric watch clocks, having a grand total of 200 stations.

Messrs. Sawyer & Blake, the New England agents of the Sprague Electric Railway and Motor Company, have just filled an order for Woonsocket, R. I., and one for Brockton, Mass.

An electric light company, composed of several prominent citizens of Gardiner, Me., was formed last week, with a paid up capital of $20,000, which includes the plant now operated by the Coliseum Purchase Company, and the one owned by Mr. A. W. McCausland, an additional 500 light incandescent plant and all necessary facilities for furnishing electric power. A station with all requisite appliances will be erected at once.

In last week's New England Notes reference was made to the prospect of the town of Hallowell, Me., being soon supplied with electric lights. Now advices give the information that the Hallowell Light and Power Company, with a capital of $50,000, has just been incorporated.

Messrs. Paine & Francis, the New England Agents of the Edison United Manufacturing Company, have just completed the installation of a 400 incandescent light plant in the Massachusetts Cotton Mills at Lowell, Mass.

The Willimantic (Conn.) Electric Light Company, whose plant was destroyed by fire a few months ago, have the new building nearly completed. The Waterhouse Company, of Hartford, Conn., has been busy during the past week putting the dynamos and other electric lighting apparatus in the new building referred to, and it is said that the Willimantic Company will be able to start up its lights about April 15.

The Hartford (Conn.) Light and Power Company recently completed its station, which, by the way, adjoins the building of the Hartford Electric Light Company. The system to be used by the former, it is said, is incandescent exclusively; and the Mather dynamos and Westinghouse engines are to be adopted. It is also reported on good authority that the Hartford Light and Power Company will use the Westinghouse alternating system for long-distance lighting.

It is reported that the Board of Aldermen of Dover, N. H., have voted permission to Mr. Henry W. Burgett, of Boston, to install an electric light plant (Thomson-Houston system); and that the board further granted Mr. Burgett the exclusive franchise to use electric lights in Dover for the period of five years. It is estimated that the cost of the plant with requisite number of lights to fill immediate demand will be about $40,000.

Mr. Vail, of the Edison Company, was in this city this week. He has recently returned from a trip west, where has been inspecting a number of Edison central stations, and he has decided to report in favor of changing many of the western stations to the same system that is working so satisfactorily in the Edison station here in Boston. The No. 2 Edison station to be started in this city is to be erected on Bowker street, and the work will be pushed as fast as possible, so as to be completed before cold weather. Mr. Vail is remodeling the Edison station at Brockton. They will erect a 900 h. p. brick chimney, put in another Armington & Sims Co. engine; also a new steam boiler to be set with the Jarvis boiler setting. A large number of Sprague motors will be added to furnish power to run elevators, shoe shops, etc.

The thrifty and enterprising citizens of Norway, Maine, are entitled to the compliments and admiration of every one interested in the advance and success of electric lighting. The property owners of that little town—with only 2,500 population—have demonstrated a spirit of progress and determination to have only the right kind of illuminant; and have thus given out an example that it would be wise for many of their New England neighbors to follow. The Norway electric light plant consists of two 30-light Thomson-Houston dynamos, which derive power from a turbine water-wheel. All the sixty lights are in use, it is said; twenty of them light the streets and the remainder are distributed among the stores, halls, etc. There exists to-day a demand for more lights in Norway; and it is said that arrangements will probably be made to light the streets and stores of the neighboring town of South Paris, only 1½ miles distant.

It is safe to predict, therefore, that the lighting capacity of the Norway plant will be increased at an early day to double the present number of lights. The prime mover in the enterprise of introducing electric lights into Norway is Mr. H. L. Horne, treasurer of the Norway Tanning Company, and it is from that gentleman's factory that the water power is obtained for driving the dynamos.

At the twelfth annual meeting of the Massachusetts Association of Classical and High School Teachers, held in this city, Mr. C. W. Parmenter, principal of the Waltham High School, read a very interesting and able paper on "How to Present the Subject of Electricity." One good point he made was that dynamo electricity should receive more attention than frictional.

The Jarvis Engineering Company of this city are setting five tubular boilers with the Jarvis setting, for the United States Electric Light Company, Washington, D. C.

Mr. John T. Moriarty, of Boston, the New England agent for the Electrical Accumulator Company, of New York, deserves credit for the painstaking piece of work just completed by him in the new building of the Massachusetts Hospital Life Insurance Company on State street, Boston. The installation is a very neat one.

I take the following on the subject from the Boston *Herald* of April 9:

The elegant new building, No. 50 State street, belonging to the Massachusetts Hospital Life Insurance Company, has had an electric lighting plant in its basement ever since it was erected, but yesterday it added a new feature, which it is expected will prove very satisfactory to the tenants. Heretofore the engines running the dynamo have stopped work about 6 o'clock in the afternoon, as it was supposed most of the occupants of the offices in the building ceased work before that time, and consequently any who had business later were compelled to rely on gas for light. Hereafter, although the dynamo will not run any later, the electric light will be available all night if desired. This result is attained by the use of a set of electric accumulators, which have been put in by Mr. J. T. Moriarty, the Boston representative of the Electrical Accumulator Co., of New York. The set consists of 108 cells for storing the electric fluid, and they are ranged on three long shelves placed in a room in the basement. The batteries combine the invention of Faure and improvements of several other discoverers. The cells consist of glass cases 8¼ inches by 11, 16 inches high, and each containing 15 plates, eight negative and seven positive. Each cell, in working condition, weighs 125 pounds. The battery, it is claimed, will run 100 lights, 16 candle-power, 10 hours, and of course a less number of lights can be run longer. The dynamo need be run only some six hours per day, part of the electricity from it lighting the building when needed and the balance being used for charging the accumulators. The incandescent lamps supply a much steadier light from the accumulators than when taken directly from the dynamo, and another advantage is that, in case of accident to the engine or dynamo, there is a supply of stored electricity to draw from.

The same company is fitting up some cars on the Old Colony and Fitchburg railroads for the purpose of demonstrating the manner in which it lights passenger cars with electricity from storage batteries, and in Philadelphia a street railway car has been fitted up with a motor to be run from storage batteries. The latter experiment is being conducted under the auspices of three or four wealthy gentlemen, who have obtained from the New York company the exclusive right to use accumulators for street cars in this country. President Richards, of the Metropolitan Railroad, is one of the gentlemen, and so satisfactory are matters progressing that he expects to have the car running in this city inside of two months. It is estimated that the motor will be able to draw two or more cars filled with passengers.

W. I. B.

SOUTHERN NOTES.

Baltimore, Md., April 9, 1887.

Few developments in the electrical business have been more remarkable than those now going on in the motor industry, and the activity at present displayed in the motor line promises to be not only well sustained for an indefinite time to come, but far-reaching in its effects. Baltimore furnishes a good idea of what can be and is being done with electric motors, and her example is one that always finds many pupils and imitators throughout the South. The Baxter Electric Manufacturing & Motor Company, with offices at 11 South street, and factory at Constitution, Monument and Buren streets, is already doing a large business here. As your readers are aware, Mr. J. F. Morrison is the managing director of the company. Mr. Benson M. Greene, the president, is an old and well-known fire insurance man, and a gentleman of wide acquaintance and influence. It would be hard to tell all that the company has done since it started; perhaps the best conception of its activity can be formed from the record of the past week, which I have obtained. It has placed in that time 10 small motors for Strouse Brothers, clothiers; a 2 h. p. for sewing machines, for M. Strouse & Co., shirt manufactuers, etc.; a 2 h. p. for Griffin, Curley & Co., printers; a 2 h. p. for Mallalieu, printers; a ½ h. p. for S. Cox, printer; 2 h. p. for the Baltimore Suit and Novelty Co.; three 1 h. p. for C. D. Kinney, for three grocery stores; five small motors for G. H. C. Neal & Son, dry goods house; two small motors for the Millington Sewing-Machine Agency. The following orders were also taken: A 6 h. p. for Clark, Perry & Co., shoe manufacturers; 10 h. p. for J. Faust & Son, shoes; 2 h. p. for Erlanger Bros., overalls; ½ h. p for C. W. Davidson, lathes; and 1 h. p. for O. F. Day & Son, harness. Somewhat a striking list that! To take one instance, to illustrate the manner of work done, the 2 h. p. motor at Griffin, Curley & Co.'s, is running three Gordon job presses, one 28×33 cylinder press and one 19×21. It replaced a 4 h. p. steam engine.

WESTERN NOTES.

Branch Office of The Electrical World,
Chicago, April 9, 1887.

The Western Edison Light Company has been consolidated with the Edison Electric Light Company, of New York, and the concern here will hereafter be known as the Western department of the home company. F. S. Gorlon and J. S. Humbird are the managers of the Western department. The offices remain at the same place, in the Adams Express Building.

The Chicago Edison Company has been incorporated by the Illinois Secretary of State, with a capital stock of $500,000; John M. Clark, John B. Drake and Robert T. Lincoln are mentioned as incorporators.

A local paper has the following interesting gossip concerning private telegraph wires: Fifteen or twenty thousand dollars seems a large sum to spend yearly for telegraphic tolls, and yet there are no less than twenty firms in Chicago who pay that amount of money every year for the use of a wire between this city and New York alone. These are mostly brokers whose business demands speedy communication between buyers and sellers in Chicago and the great market on the New York Stock Exchange. Ten years ago the ordinary telegraphic communication between the two cities sufficed, but as it frequently took as much as half an hour to deliver a message on the Stock Exchange, even when a broker's orders, which were given the preference over everything, it was necessary to find some means of almost instantaneous communication. Stocks might greatly decline or advance several points between the time an order was telegraphed here and received on Wall street. In 1878 J. T. Lester & Co. put in a wire from their office to the Western Union Telegraph Company's building and leased from that corporation a wire to New York, for which the sum of $25,000 was to be paid annually. This didn't include the wages of operators, which amounted to $2,500 more. The scheme was a big one, but soon paid enormously. Speculators saw the advantage of having direct communication with Wall street, and the other brokerage firms were soon compelled to lease wires or stop contending for business. Then the Baltimore & Ohio line came in and leased wires for $20,000 a year, and the Western Union met the cut. The Baltimore & Ohio cut to $15,000, but the other corporation wouldn't stand the reduction, and the price for Baltimore & Ohio wires went to $18,000 per year, which is now charged on all new contracts, while some old ones bring but $15,000, and the firms holding contracts with the Western Union pay

$20,000. Besides the score of private wires leased by firms having offices in New York two are operated by the Open Board of Trade, which have a terminus on the floor of the Stock Exchange, and another on the floor of the Open Board here. There are three firms which have private wires to Minneapolis and St. Paul. There are four leased wires to Milwaukee, three to St. Louis, two to Indianapolis, and one to New Orleans, all controlled by houses having branch offices in those cities. There are some quick transactions over private wires on record. Of course, the "tickers" give the New York stock quotations almost at the moment they are made, and an operator standing in the office of a broker here can give an order to the operator at the private wire and have it in the Wall street office of the firm at once. It is said that "Norm" Ream went into a broker's office the other day and ordered 1,000 shares of Missouri Pacific bought. The order was sent to the New York office, the stock bought and Ream notified of the fact within fifty-five seconds. There are many similar instances quoted, and "the boys" swear to their truth. The wires in all the big offices are kept busy all day, and are now said to be a good investment, even at a rental of $20,000 per year.

The Secretary of State for Illinois has issued licenses of incorporation to :

The Wanless Manufacturing Company, of Chicago ; capital stock, $300,000 ; object, for the manufacture of electrical appliances. Thomas Wanless, E. B. Hamlin and John M. Wanless, incorporators.

The Streator Manufacturing Company, of Streator ; capital stock, $10,000 ; object, to manufacture electric augers. Milton Hicks, Z. O. Jackson and D. Heenan, incorporators.

The Milwaukee Avenue Electric Company ; capital stock, $30,000. Incorporators, Alfred L. Baker, Charles R. Webster and William W. Casey.

Mr. S. Taussig, agent for the Synovial oils, No. 43 River street, Chicago, has been on an extended trip among the electric light people, and finds a liberal demand for this excellent oil for dynamo use. Mr. Taussig makes deliveries of this oil either from Chicago or New York.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations :

Bell of Mo.	$155@$157
Central Union	54@ 55
Chicago	375@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Michigan	72@ 73
Rocky Mountain Bell	40@ 45
Wisconsin	105@ 107

W. A. K.

THE TELEGRAPH.

Western Union Stock.—The Western Union Telegraph Company has notified the New York Stock Exchange of the issue of 12,000 shares of new stock for the purpose of retiring scrip. Under the rules of the Exchange this will not be a good delivery for thirty days.

Commercial Cables.—At the time of the breaking of the Commercial cables, the employés throughout the country at once offered Mr. Mackay to put themselves on half pay while the interruption lasted. The proposition was declined, and the breaks were repaired with unusual rapidity.

A Censure.—At St. Thomas, Ont., on April 7, the coroner's jury in the case of the victims of the wreck on the Michigan Central found a verdict against Brown, the nineteen-year-old operator, who neglected to flag the train, and censured the company for employing boys. Brown has fled.

The French Cable Fight.—Both the Western Union and Direct companies, according to affidavits just filed in a suit for injunction, have continued to accept messages for the French Company, send them, and receive compensation therefor. As a preparation for the present suit, R. H. Griffin, who is associated with Col. Robert G. Ingersoll, attorney for the corporation, tendered messages marked "*via* French Cable," and they were received and sent. He also, when he asked for blanks, was furnished by both corporations with blanks printed "*Via* French Cable." Accordingly, an injunction has been asked for, which was granted by Judge Donohue, in the Supreme Court, Chambers, restraining the Western Union and Direct companies from issuing the French Company's blanks; from transacting business intended for the French Company, and from advertising or holding itself out in any way to the public as the French Company.

Bankers & Merchants' Company.—Referee John Whalen, who was appointed by the New York Supreme Court to pass on the accounts resulting from the sale of the Bankers & Merchants' Telegraph Company under foreclosure, has filed his report. Edward S. Stokes purchased the property for the United Lines Telegraph Company for $500,000, upon certain conditions. He paid $50,000 down, and, in August, 1885, paid in receiver's certificates of the face value of $509,776. The referee says that he has paid out by direction of the court $25,520 on various claims. He has also received claims filed by the purchaser, alleging that they were made to satisfy obligations incurred by Receivers Newcomb and Smith, J. B. Butler and J. G. Farnsworth, and claiming credit as advances made on account of receivers' indebtedness aggregating $99,766. Other claims amounting to $83,480 have been filed, the parties claiming to be entitled to a share of the proceeds of the sale. Referee Whalen is unable to accurately estimate the value of the receivers' certificates, but thinks they might be worth 60½ cents on the dollar. If this estimate be correct, there would now be due from the purchaser at least $32,991.

THE TELEPHONE.

New York Telephone Rates.—It is thought likely that the Cullen telephone rate bill will be smothered in the Legislature, and that the rates will be left as they are.

Folding Telephone Desks will, it is reported, be made by the Commercial Patent Development Company, of this city. The concern has a capital of $25,000. Mr. F. Lemoine, of Manchester, is one of the incorporators.

THE ELECTRIC LIGHT.

Knoxville, Ia.—The Knoxville Electric Light Company will proceed to put in a plant.

The Union Light Company, of Lincoln, R. I., has been formed by J. E. Goldsworthy and others.

Springfield, Mass.—The Agawam Manufacturing Company is installing a Loomis incandescent plant.

American Dividend.—The American Electric Manufacturing Company will declare a quarterly dividend of 1½ per cent., it is said.

Cambridge, O.—The Local Gas-light Company is now the Light, Heat and Power Company and will give attention to electric lighting.

Hallowell, Me.—The Hallowell Light and Power Company, capital $50,000, has incorporated. Mr. E. A. Sanborn is the president of the company.

Lamar, Col.—The Lamar Gas and Electric Light Company, recently incorporated by P. Tommlitz and others, has a captial stock of $50,000.

Muskegon, Mich.—A special dispatch reports the destruction by fire of the electric light station at Muskegon, Mich. ; damage, $15,000.

McPherson, Kan.—The McPherson Thomson-Houston Company has been incorporated by W. J. Bell and others, with a capital stock of $30,000.

Grand Rapids Mich.—The Grand Rapids Edison Light and Fuel Company, incorporated by W. R. Shelby and others, has a capital stock of $200,000.

New York City.—The *Graphic* (daily illustrated) paper put in a plant of the American system lately, to be used chiefly in the photographic department.

Shenandoah, Pa.—The Citizens' Electric Light Company, of Shenandoah, has been incorporated, with a capital stock of $25,000. Mr. W. Kemmell is the treasurer.

Summit, N. J.—A stock company is being formed in Summit, the object of which is to introduce the electric light in that town. It is proposed to purchase a $20,000 plant.

Westinghouse Work.—The present lamp capacity of the Westinghouse Company is said to be 4,000 lamps per day, to be increased at once to 8,000, to meet the demand.

A Large Factory.—The Edison Machine Works, Schenectady, employ between 600 and 700 men, and have started some of the departments on night and day runs. The capacity of the works is 2,000 dynamos a year.

Storage Battery Litigation.—The Brush Electric Light Company has begun a suit in the United States Circuit Court against the Electrical Accumulator and Julien Electrical companies for an alleged infringement of patent.

A New Construction Company.—The Glover-Davis-Hitchcock Company, of New York, has been incorporated, with a capital stock of $2,000, by C. S. Glover, Jr., and others, who are interested in construction and have latterly done considerable work for the Westinghouse Company.

Electric Trust, Philadelphia.—The Electric Trust of Philadelphia, organized to supply the city with electric lights, has begun operations with a capital of $3,000,000. Preferred stock to the amount of $500,000, bearing 5 per cent. annually, is about being sold. The president is J. Lowber Welsh.

Pittsburgh, Pa.—It is understood that Mr. Geo. Westinghouse, Jr., of Pittsburgh, has purchased a controlling interest in the Allegheny County Light Company, which operates arc and incandescent electric lights in Pittsburgh and Allegheny, and also supplies power for electric motors. The plant of the Allegheny County Light Company is one of the most complete in the country.

Plainfield, N. J.—The Westinghouse alternating station reports a large and growing business with patrons all well pleased. Over 600 incandescents are now in use, and several weeks must pass before the new contracts pouring in can be filled. A large church has recently been lighted with great success. Preparations are making for a very large increase in the plant. Some 75 Thomson-Houston arcs are being operated from the same station.

Train Lighting.—The New York Senate Railroads Committee reported a bill on April 6 to prohibit the use of stoves or other heaters from which, in case of accident, the burning fuel may escape, or of lamps burning combustible materials, on passenger trains. The act is to go into effect on May 1, 1888. It does not apply to mixed trains, and the provision concerning stoves does not apply to short roads operating less than 30 miles of track.

Gas Engines in Germany.—The gas-motoren-fabrik Deutz, of Deutz, Germany, who own the "Otto" patents in Germany, and attracted attention of late by the large sizes of Otto engines furnished to city water-works and electric light stations, have just obtained a decision in their favor, it is stated, in their suit against Moritz Hille, of Dresden, a manufacturer, and several of his clients and users of infringing engines. The decision establishes the infringement by the defendants, and orders them to discontinue the manufacture and use of the machines; also to account for damages. The Hille engine used the well-known Otto four-stroke cycle, and it is against its use that also other suits still pending against Körting Bros. and Buss, Sombart & Co. are directed. In these cases a decision may soon be expected.

Electric Headlight.—There are five electric headlights in use on the Cleveland, Akron & Columbus Railway, which the president of the road declares make an annual saving to the company of not less than $50,000, probably a good deal more, by preventing accidents. The gentleman said that the lights could be seen at night seven miles if objects did not obstruct vision. Numerous incidents were related. An engineer saw at night, by the aid of the light and reflector, a horse on a bridge a mile away. The narrator had read a newspaper at night, unbelievable as it seemed, by aid of the light nearly or quite three miles away. An engineer who could not see a tie or other obstruction on the track half or three-quarters of a mile away by an electric headlight had no business on the locomotive. An electric headlight and apparatus costs about $400. The little dynamo is driven by an independent little engine on the boiler of the locomotive back of the sand dome.

APPLICATIONS OF POWER.

The C. & C. Motor Company are now making their motors up to 1 h. p., and find a very large demand for those of that size as well as for the smaller ones.

The First Julien Car destined for the tramway at Rio de Janiero, Brazil, was recently subjected to a trial trip in Brussels. A large company of distinguished men were present, and the car worked to perfection. One of our Brussels contemporaries gives a view of the car, an open one, showing hardly a sign of difference from those in use now, except in the absence of the horses.

Broadway, New York, is still, and more than ever, the bone of contention between parties trying to obtain the use of the thoroughfare for rapid transit purposes. A determined effort is now being made to secure it for an elevated road. The use of electric motors is probable, whether the road be elevated or underground, and the chances for the latter are yet very good, it would appear.

Ithaca, N. Y.—The contract for an electric railway at Ithaca has been closed between Haines Brothers and the Safety (Daft system) Electric Power Company, of New York City. Great interest in the enterprise is felt by the authorities and students of Cornell University, whose endowment, it will be remembered, came originally through electrical developement. It is said that the road will be put in operation this summer.

Electrical Railways in Russia.—According to the Moscow *Technik* a project has been set on foot by some Belgian capitalists for the construction of a short railway in Russia to be worked by electricity, and to connect the towns of Varsovie, Wilanow, Mokotow and Czerniakow. The necessary concessions have already been applied for ; if they are granted this will be the first introduction of electric railways in the Russian Empire.

Motors for U. S. Men of War.—The Naval Ordnance Bureau has under consideration a plan by which electricity can be utilized on board men-of-war in loading, pointing and firing heavy guns. It is thought that the use of a dynamo and a motor to generate force for these purposes will be a marked improvement over the steam apparatus now in use. The electric machines, it is maintained, will occupy less space, and will be less likely to get out of repair.

PERSONALS.

Ex-Representative Hall, of Iowa, has been appointed Commissioner of Patents, to succeed Mr. Montgomery. Mr. Hall brings with him an excellent reputation for ability and probity, and will find in his new duties full opportunity for the exercise of his highest powers.

Mr. C. J. Kintner has resigned his office as Principal Examiner in Electricity of the United States Patent Office, in order to associate himself in business with Mr. John A. Wiedersheim, solicitor of patents, Philadelphia. Mr. Kintner retires from the Patent Office with very high testimonials from Secretary Lamar and Commissioner Montgomery.

SPARKS AND FLASHES.

Wire Laying.—Cyclones, like politicians, are notorious for laying wires.

Burglar Alarms.—Agent—Have you a burglar alarm in your house, Madam? Lady of the house—Well, we did have, last week! A burglar came into the house Tuesday night and fell over a stack of milk pans. Talk about alarms! you ought to have heard that.—*Burlington Free Press.*

BUSINESS NOTICES.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Electric Gas Lighter.—The new electric gas lighter sold by the Electric Brush and Ozone Company, 102 Fulton street, N. Y., is meeting with a large sale. Several agencies have been established, and it will be well for those desiring to handle a good salable article to apply as early as possible. See card, page iii.

H. Andres, 22 and 24 North Fourth Street, Philadelphia.—The only genuine raw-hide goods made in the United States. Belting, lacing and straps of all kinds or hard raw hide, lathes, planers, lubricators, fans, blowers, vacuum and steam pumps, cotton and leather belting, emery wheels and machinery of all kinds.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks :

April 13, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	25	40
Am. Tel. & Cable	76	77
Cen. & So. Am.	95	100
*Com. Tel		
*Gold & Stock		
*Inter. Ocean Tel.		
N. Y. Mutual	75	80
Pac. & Atl.		
*Postal T. & C.	25	35
South. & Atl.		
W. U. Tel.	77⅛	77¼
W. U. Scrip	73	
W. U. Bonds	119	
Mut. U. Bonds	88½	89
TELEPHONE.		
Am. Bell	225	226
Am. Speaking	110	120
Erie	28¼	28⅞
*Hudson River		60

TELEPHONE.	Bid.	Asked.
Mexican	1¼	1⅜
*N. Y. & N. J.	87½	93
N. Y. & Pa.		
New England	43½	44
*Southern Bell	120	135
ELECTRIC LIGHT.		
*Am. Electric		
*Brush		
*Brush Ill		
*Consolidated		
*Daft		
*Edison	235	240
*Edison Ill	95	105
*Edison Isolated		
*United States	40	
*U. S. Ill	90	95
MOTOR.		
*Daft		
*Sprague		

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

MISCELLANEOUS NOTES.

Electrical Treatment.—At Harrisburg, on April 6, the Pennsylvania Legislature passed a bill providing that punishment for murder in the first degree may be death by the use of electricity.

Silk vs. Wire Suspensions.—Mr. R. H. M. Bosanquet has pointed out that the silk fibre suspension in galvanometers is apt to prove capricious and produce deflections due to its own condition. He has, therefore, substituted fine wire with a gain in certainty if a loss in delicacy. In connection with this subject we may mention the Wollaston platinum wire which was drawn in a silver tube; the silver being afterwards dissolved away by acid. Specimens of this wire are known to have a diameter of one-fourth or one-fifth thousandth of an inch.

Buffalo Electrical Society.—Mr. Thomas A. Laird, wire chief of the Western Union Telegraph Company, delivered a lecture recently before the society on the Wheatstone bridge system of measurements, describing the apparatus and making many experiments.

The McMahon Trial.—The evidence of ex-Senator Ecclesine has been taken in the suit of Mr. W. McMahon against Mr. M. B. Flynn, for a part of the subway stock. Mr. S. De Kay, of McMahon's counsel, has also gone on the stand. The evidence of both has been given in McMahon's behalf, as to the terms of the alleged contract.

Cowles Electric Smelting.—The Cowles Electric Smelting and Aluminum Company, of Cleveland, O., are now exhibiting what they call aluminum steel. In a sample bar of iron welded to a bar of Siemens-Martin basic steel with one-fifth of 1 per cent. of aluminum added, no line of weld can be seen, the characteristics of the steel appearing to extend far into the iron. Without the aluminum a clearly defined weld is visible between iron and the same steel. The same firm show a forged bar of aluminum bronze, with 5 per cent. of aluminum; this broke at 36 tons per square inch of original section, with 60 per cent. elongation.

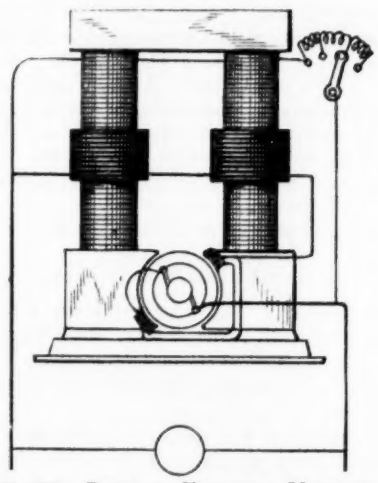
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MARCH 29, 1887.

(1) 359,990. Railway Car Telegraphy; (2) 360,266. Annunciator and Shunt Circuit Therefor; J. A. Barrett, New York, N. Y., Assignor (1) to the Railway Telegraph Company, of same place. Applications filed respectively April 1, 1885, and Dec. 7, 1886. (1) These devices relate to the well-known system of railway telegraphing by induction. (2) A device for increasing the efficiency of calls or signals for telephones.

359,999. Watchman's Time Recorder; E. J. Colby, Chicago, Ill. Application filed Jan. 13, 1886. Structural details relating to this kind of mechanism.

360,002. Reflector for Electric Lights; W. W. Downing and A. B. Upham, Peoria, Ill., said Upham Assignor to said



360,258. DYNAMO ELECTRIC MACHINE.

Downing. Application filed May 10, 1886. A series of horizontal reflectors are arranged above the lamp.

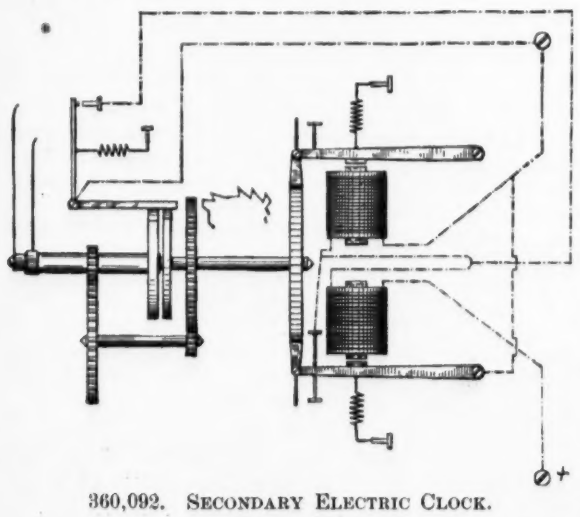
360,024. Galvanic Battery Solutions; W. P. Kookogey, of New York, N. Y. Application filed Dec. 8, 1885. Bichromate of potash or bichromate of lime is dissolved in hot water, sulphuric acid is then added and the whole allowed to stand and cool, then the liquid is decanted, leaving the crystallized sulphate salt.

360,025. Electric Signal System; C. Lambdin, Wilmington, North Carolina. Application filed Aug. 23, 1886. This is a device whereby a bell is allowed to ring only a limited amount of time, no matter how long the button is held closed.

360,030. Armature for Dynamo-Electric Machines; Wm. A. Lerper, of Lynn, Mass., Assignor of one-half to W. R. Johnston, of Sherbrooke, Canada. Application filed Feb. 28, 1887. The construction of this armature is such as to avoid heating to a great extent and to increase the efficiency and lessen the cost of construction.

360,040. Apparatus for Suspending Arc Lights; G. P. Nichols and Moses Coombs, Jr., Youngstown, Ohio. Application filed July 26, 1886. A mast arm provided with improved devices.

360,060. Electric Car Brake; E. A. Sperry, of Chicago, Ill. Application filed June 3, 1886. This consists in the em-



360,092. SECONDARY ELECTRIC CLOCK.

ployment of two circuits, one normally open and controlling the operation of the brakes and the other closed and controlling the operation of translating devices in the open circuit.

360,068. Telephone; H. E. Waite, New York, N. Y., Assignor to Chas. F. Livermore, Trustee, of same place. Application filed Jan. 26, 1886. In this device the core of the helix does not act directly upon the diaphragm, but the latter is affected by a bar or piece which may be adjusted so as to regulate its relations to the diaphragm and the helix, and the core may be adjusted in the helix with relation to the bar so that good results are obtained.

360,077. Railway Signal; G. H. Wright, San Francisco, Cal. Application filed March 31, 1886. This is a device whereby a train moving in one direction may automatically indicate the fact to a train moving in an opposite direction.

360,078. Primary Electric Clock; J. J. Abell and C. B. Gifford, Colesburg, Ky. Application filed Nov. 27, 1886. This invention consists in the combination of the escapement wheel, the anchor and the spring to move the escapement wheel during the interval when it is disengaged by the points of the anchor.

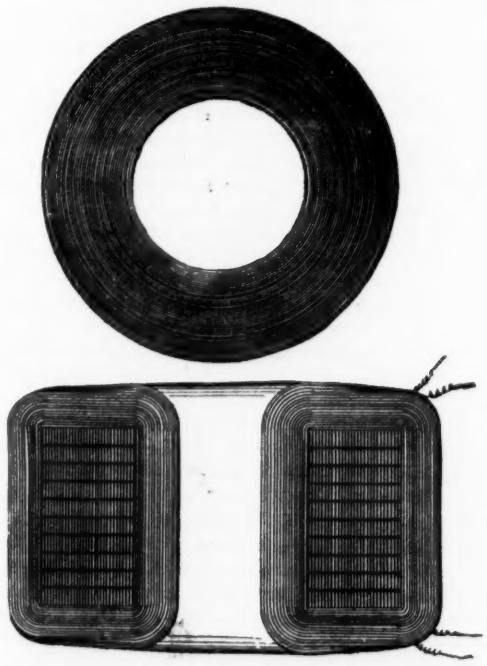
360,092. Secondary Electric Clock; Wirt B. Harvey, Memphis, Tenn. Application filed Dec. 7, 1885. Specific devices are employed whereby the secondary clocks of a system may be set simultaneously at certain intervals. See illustration.

(1) 360,122. System of Electrical Distribution; (2) 360,123. Electro-Magnetic Cut-Off; (3) 360,124. Automatic Cut-Off; (4) 360,125. System of Electric Distribution; E. Thomson, Lynn, Mass., Assignor of (1) to the Thomson-Houston Electric Co., of Connecticut. Applications filed respectively May 21, 1884, Aug. 25 and Sept. 6, 1886. (1) This invention is designed to operate electric arc and incandescent lamps in such way as to avoid the danger in the incandescent circuit of shocks and grounds that would affect the operation of the arc lights. (2) This invention makes allowances for either abnormally high or low resistances in a circuit caused by the rupture of the carbon in an incandescent lamp. (3) This invention is designed to do away with the use of the dash-pots or contact-holding mechanism of the apparatus described under No. 2. (4) For description see page 193 this issue.

360,127. Electric Sole; F. B. Wallis, Everett, Mass. Application filed Aug. 30, 1886. This electric sole may be permanently connected with or detachably placed within a boot or shoe.

360,144. Electric Furnace; E. H. and A. H. Cowles, Cleveland, Ohio. Application filed Oct. 16, 1885. This is a device whereby the heat of the furnace affects an electric current in such a manner as to cause it to operate devices which control the valve for feeding fuel to the furnace.

360,151. Arc Lamp; L. Hanson, Halifax, England. Application filed Sept. 3, 1886. In this lamp the carbon rod is suspended by a cord which passes over pulleys and is wound up on a



360,198. INDUCTION COIL.

drum. The drum is controlled by clock work which is locked and released by the magnets.

360,158. Galvanic Battery; P. Jablochkoff, Paris, France. Application filed Nov. 26, 1886. A battery combining an oxidizable metal, a substance having the property of accumulating hydrogen, and a substance having the property of accumulating oxygen.

360,175. Electric Railway Signal; J. McM. Scott, of Allegheny, Pa. Application filed April 16, 1886. The object is to provide a block signal which the operator cannot change without notifying the central office.

360,198. Induction Coil; O. T. Bláthy, Buda-Pesth, Austria-Hungary. Application filed Oct. 11, 1886. An induction coil consisting of a series of superposed rings, each made of coiled iron ribbon, with insulation between the layers, and two or more sets of copper conductors for the primary and secondary currents wound on the core formed by the series of rings. See illustration.

360,216. Electric Motor; F. E. Fisher, of Detroit, Mich. Application filed Jan. 11, 1886. In motors wherein the neutral point is practically fixed a magnetic shield is interposed between the armature and poles of the field magnets.

360,223. Electrical Apparatus for Heating and Cooling Buildings; E. H. Johnson, New York, N. Y. Application filed Oct. 8, 1886. This invention is designed to utilize the excessive heat or cold of one room or portion of a building to modify the temperature in another part. See illustration.

360,224. Electric Lamp and Socket; C. G. Perkins, of Hartford, Conn. Application filed Oct. 11, 1886. The object of this invention is to provide a socket and its appurtenant switch, which shall be certain in its operation.

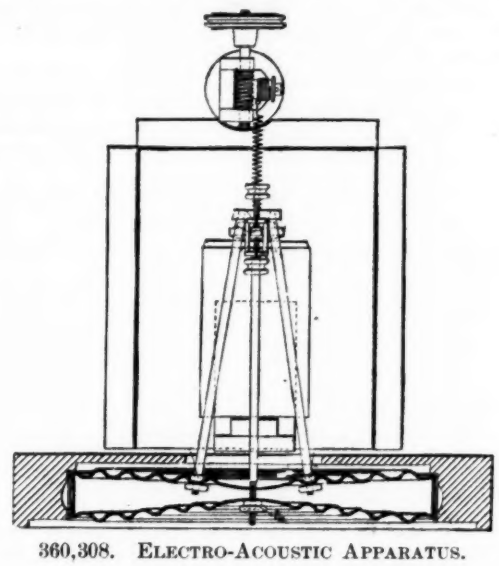
360,252. Lamp-Post and Signal; W. C. Smith, of New Haven, Conn., Assignor of one-half to J. P. Brewer, of the same place. Application filed Aug. 13, 1886. Lamp-posts are constructed and fitted with appliances which will enable policemen or other authorized persons to send in signals to station.

360,254. Electric Arc Lamp; John Tregoning, of Hartford, Conn. Application filed Sept. 24, 1886. Improvements in the feed and clutch mechanisms are described.

(1) 360,258. (2) 360,259. Dynamo Electric Machines; H. E. Walter and C. Batchelor, of New York, N. Y. Applications filed Nov. 6, 1886. In these machines the non-sparking points of the commutator will remain constant, so that the position of the brushes will not have to be changed. See illustration (1).

360,308. Electro Acoustic Apparatus; A. A. Knudson, Brooklyn, N. Y. Application filed June 15, 1886. This is a device to be attached to the receiving mechanism of a telephone to increase the sounds or vibrations produced therein. See illustration.

360,316. Conduit for Underground Conductors; H. Loesner and M. De Bravura, of New York, N. Y. Application filed Dec. 31, 1886. Plates of glass having registering edges



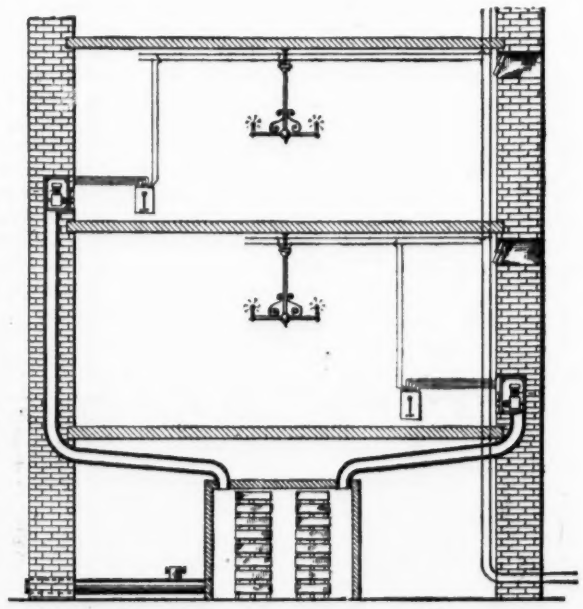
360,308. ELECTRO-ACOUSTIC APPARATUS.

are placed together, and they are formed so that grooves will be left in which the conductors are to lie.

360 354. Insulator; Wm. F. Locke, of Concord, N. H. Assignor of one-half to J. E. Robertson, of same place. Application filed Oct. 1, 1886. This insulator consists of a hollow cylinder of non-conducting material, which is secured to a base by a rod or screw passing through it longitudinally.

360,362. Mechanical Telephone; C. M. Radford, Concord, N. H. Application filed Aug. 31, 1886. It is designed to increase the vibrating power of the diaphragm in the direction of the line wire so that long-distance lines may be successfully operated.

360,375. Automatic Electric Circuit Controller; T. P. Conant, Brooklyn, N. Y., Assignor to the Electrical Accumulator Co., of New York. Application filed Nov. 11, 1886. Apparatus for automatically controlling the circuit in which



360,223. ELECTRICAL APPARATUS FOR HEATING AND COOLING BUILDINGS.

the energy of a primary generator is conveyed to a secondary battery or accumulator.

360,377. Arc Lamp; W. A. Crowdus and H. M. Sutton, Dallas, Texas. Application filed Oct. 1, 1886. This invention embraces improvements in the feeding and cut-out mechanisms of arc lamps.

360,381. Electric Indicator; F. K. Fitch, of New York, N. Y. Application filed Oct. 29, 1886. Mechanical details by means of which, together with the electric current, numbers, figures or signs are caused to be displayed at a distant point which indicate the point whence the signal came.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.